THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 27. Thursday, June 21st, 1923. No. 357.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1923-24, Oliver Stubbs, M.I.Mech.E., Openshaw, Manchester.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, 38, Victoria Street, London, S.W.1.

Lancashire: T. Makemson, 21, Beresford Road, Gorse Hill, Stretford, Manchester.

Birmingham: H. James Roe, 33, Herbert Road, Bearwood, Birmingham.

Sheffield and District: W. A. Macdonald, 62, Bannerdale Road, Sheffield.

Scottish: W. H. Bound, 69, Minard Road, Shawlands, Glasgow.

London: V. C. Faulkner, 21, Stanley Gardens, W.11.

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East Midlands: H. Bunting, 17, Marcus Street, Derby.

Coventry: J. M. Meston, 37, Melville Road.

West Ridings of Yorkshire Branch: A. Love, 232, Gladstone Street, Bradford.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

The Manchester Conference.

Several factors operated against a record attendance at the Manchester Conference. Primarily, there was no foundry exhibition, and secondly, although not yet supported by statistics, a distinct slump in the foundry trade is being experienced; and lastly, there is the competition of the second international foundry congress to be held in Paris in September. Numbers, however, are not the essentials of a successful conference: in fact, too many can cause congestion and introduce certain discomforts. The Manchester Conference was a success, regarded from the technical and social aspects. Of the Papers presented, two had reference to steel castings, and one could not help but regret the small number of steel-foundry representatives present. However, the presentation of Papers of this character will tend to make steel foundrymen more interested in the work of the Institute in the future. The Paper on core oils was well discussed, and though many suggested the disclosing of the names of the brands, this was obviously impossible. As a result of the Paper, we trust that manufacturers of core coils will be more explicit in their instructions as to the mixing of their various brands.

Professor Siegle's Paper was an excellent review of the work done and still necessary to be accomplished on the grading of cast iron. When—as some day it will become inevitable—a national committee is set up to tackle the provision of pig-iron to analysis, this Paper will be of great use as a review of past efforts.

It is difficult to say which of the visits and excursions was the most interesting. The works of Messrs. Hans Renold gave lessons in the organisation of quantity production, the working up of cast iron and other metal alloys, the administration of welfare work, and the possibilities of chain driving instead of belting. The visit to the Derbyshire Silica Brick Company not merely enlightened foundrymen as to the manufacture of a material they constantly handle, but exhibited an excellent plant lay-out in the midst of rural surroundings. The trip down the Manchester Ship Canal, being personally conducted by the chairman of directors and his colleagues, gave British foundrymen an opportunity of getting a better grasp on world trade and how it is handled. The control of the cranes by means of portable shoulder-strap-suspended controllers was a method capable of application to some metallurgical transport problems.

The annual dinner was outstanding in the high order of the speeches given. They were masterly *exposés* of after-the-war economics. The presence of Mr. James Porter, the President of the National Union of Trade Workers, emphasised the good feeling existing between the Institute and the foundry worker, whose sympathetic interest, if not direct co-operation, is almost an essential to progress.

The Oliver Stubbs medal was presented by the Lord Mayor of Manchester to Mr. W. H. Sherburn, of Warrington, and, judging by the reception he received, no more worthy recipient could have been found. Mr. Sherburn is Britain's foundryman-idealist, and his sterling work for the Institute of British Foundrymen has now received its reward. We offer him our heartiest congratulations.

The election of Mr. Oliver Stubbs to occupy the presidential chair a second time was extremely popular, and the Institute are to be congratulated on securing his services for a further period. We trust that business will allow him to take the same devoted interest in the affairs of the Institute which characterised his previous year of office.

The thanks of the Institute are due to Mr. Stubbs, who, together with Mr. R. A. Miles and Mr. Tom Makimson, did so much to make the Manchester Conference an outstanding success.

Finally, the visitors are deeply indebted to the Lord Mayor of Manchester (Councillor W. Cunliff), Mr. Bacon (Chairman of the Manchester Ship Canal), Mr. Hans Renold (Chairman of Messrs. Hans Renold, Limited), and Alderman F. J. West (a director of the Derbyshire Silica Firebrick Company, Limited).

XUM

List of Visitors Attending the Conference.

George Ball (Hyde), F. Batty (Sheffield), A. S. Beech (London), W. H. Blackburn (Walsall), W. H. Bound (Scotland), E. H. Broughall (Vice-President, Coventry), R. Buchanon (Past-President, Birmingham), J. Cameron (Kirkintilloch), A. Campion (Glasgow), A. S. Coggan (Halifax), J. J. Coleman (Blackburn), B. L. Collins (Bathgate, N.B.), F. J. Cook (Past-President, Birmingham), D. Dalrymple (West Bromwich), J. G. Dobson (Birmingham), A. Edwards (Cheltenham), H. Cole Estep (London), V. C. Faulkner (Editor, FOUNDRY TRADE JOURNAL, London), A. Firth (Sheffield), Tom Firth (Past-President, Sheffield), J. W. Gardom (Luton), W. H. Grandison (Salford), T. E. Hull (Huddersfield), R. H. Hargreaves (Manchester), E. Henderson (Stockport), E. Carey Hill (Coventry), A. Hodgkinson (Manchester), A. Hodgson (Manchester), J. Hogg (Burnley), W. Holland (Stretford), W. Hollinworth (General Secretary, London), B. Horrocks (Ashton-under-Lyme), Jno. R. Hyde (Sheffield), L. Jackson (Sheffield), Wm. Jolly (Manchester), H. Jowett (Rochdale), J. Kerfoot (Loughborough), H. M. Lane (Detroit, U.S.A.), J. Little (Past-President, Sheffield), P. Longmuir (Past-President, Sheffield), C. H. Luke (London), W. A. Macdonald (Sheffield), C. Mace (Manchester), T. Makemson (Manchester), T. W. Markland (Bolton), W. Marshall (Armadale, N.B.), J. Masters (Stalybridge), A. H. Maybrey (London), J. McEachen (Kirkintilloch), T. McGrath (Wolverhampton), J. McLachlan (Birkenhead), W. H. Meadowcroft (Tyldesley), R. A. Miles (Manchester), H. Mills (Middleton), E. Oakden (Manchester), M. F. Orme (Hyde), R. O. Patterson (Vice-President, Newcastle), W. Parker (Halifax), W. N. Pellat (Bolton), F. S. Perkins (Stoke-on-Trent), J. F. Pollard (Burnley), W. H. Poole (Keighley), J. G. S. Primrose (Manchester), Chas. B. Pugh (Walsall), W. Ranicar (Tyldesley), W. Rawlinson (Bolton), Matt Riddell (Past-President, Falkirk), H. L. Reason (Past-President, Birmingham), E. L. Rhead (Manchester), A. Rhydderch (Sheffield), G. E. Roberts (Coventry), G. P. Roberts (Bury), J. G. Robinson (Halifax), Frank Russell (Sheffield), S. H. Russell (Leicester), G. Senior (Sheffield), J. Shaw (Sheffield), H. Sherburn (Warrington), W. H. Sherburn (Warrington), J. Simkiss (Manchester), J. N. Simm (Monkseaton), H. O. Slater (London), J. Smethurst (Warrington), S. G. Smith (Stretford), H. Stead (Stalybridge), O. Stubbs (President, Manchester), R. W. Stubbs (Manchester), J. W. Sykes (Leeds), W. Sykes (Sheffield), H. Thompson (Bolton), W. Thomas (Detroit, U.S.A.), T. Vickers (Sec., B.C.I.R.A., Birmingham), R. C. Waddell (Glasgow), E. H. Wainford (Darlington), H. E. Warner (Sheffield), J. J. Watson (Huddersfield), W. Whitehouse (Birmingham), H. Winterton (Glasgow).

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Pearlitic Cast Iron and Bases for C.I. Classification.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have been very interested in the leading article in THE FOUNDRY TRADE JOURNAL of June 7 regarding the classification of cast iron according to its combined carbon content.

Plain combined-carbon steel can be, and is, so classified because with properly normalised material its properties vary with its percentage of carbon. Cast iron, however, presents a much more complex problem on account of the many other factors which intervene and upset such a simple classification. For example, a cast iron containing, say, 0.8 per cent. of combined carbon and 2.5 per cent. of graphite will have very different properties from one containing the same amount of combined carbon but 3 per cent. of graphite. Similarly, two samples may have the same amount of combined carbon and graphite, and yet be physically and structurally different, due to differences in the size, form and distribution of the graphite.

Therefore it appears that if carbon is to be used as a basis for classification, it is essential that not only must the amounts of combined and free carbon present be taken into consideration, but also its structure, form and arrangement. This directly leads to a very difficult problem, namely, how to measure and define the distribution of graphite in cast iron.

In your article you referred to a Paper given by myself earlier this year, in which was a table showing the variation of the micro-structure of cast iron with the combined carbon content. I should like to mention, however, that this table was given as a help and guide to the microscopic analysis of cast iron rather than an attempt to classification, which, as I have stated above, is not possible on the one basis only.—Yours, etc.,

COLIN GRESTY.

14, Roseworth Avenue, Gosforth,
Northumberland,
June 7.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In a recent leading article, dealing principally with Professor Bauer's Paper, you mention my name in connection with the question of sulphur-manganese balance. Bauer says that "high sulphur content, which most foundrymen fear more than anything, does not appear to be detrimental to pearlitic cast iron," but he seems to have missed the point that his sulphur was "balanced," and therefore beneficial rather than detrimental.

Bauer's Paper consists of a description of three cast irons, each one entirely different from its fellows, and he appears to expect our amazement when he shows that each has different physical properties, the one with 0.8 per cent. combined carbon having the best. His logic would appear somewhat prejudiced in favour of "pearlitic" iron, because from the figures given in his Paper it could be as easily argued that the superior results of sample "P" are due to the fact that it had less silicon than the other two, or that it had the least graphite, or that it had the most manganese, or that it had the least phosphorus, or that it had the most sulphur. What Bauer has done is to take an iron better than two other irons and say that it is due to the pearlite, and that therefore pearlitic iron is the best of all irons. Having chosen two other irons of such quality that they would enhance the glory of the pearlitic one, the result was known before the tests were made.

In any case, Professor Bauer may rest assured that ordinary cast iron containing 0.8 per cent. combined carbon is not the best cast iron; also, when we desire 0.8 per cent. combined carbon we shall choose pig-irons of such composition as will give us 0.8 per cent. in the more important sections of the casting we desire to make.

Regarding the general classification of cast iron, it is my experience that the quality, quantity and disposition of the pearlite, graphite, phosphides and sulphides are all of importance, as also are the quantities of silicon and manganese. The view that the mere quantity of combined carbon represents the final expression of the impurities and indicates the final properties of the metal is one for which I have found no proof whatsoever.—Yours, etc.,

HORACE J. YOUNG.

16, Ashfield Grove,
Whitley Bay, Northumberland.

MR. J. HOGG, who is well known to members of the Institute of British Foundrymen, having been secretary of the Lancashire Branch and President of the Burnley Section, has been appointed Lancashire representative for Messrs. James Durrans & Son, foundry supply manufacturers, of Penistone.

Overheard at the Conference.—"When I first came to Europe, I immediately called on my old friend, Mr. X, of Paris, and we talked over foundry problems for 74 hours, but we only managed to touch the fringe of the subject, so as soon as this Conference is over I am going right back to Paris to finish the talk."—Some chat!

INSTITUTE OF BRITISH FOUNDRYMEN.

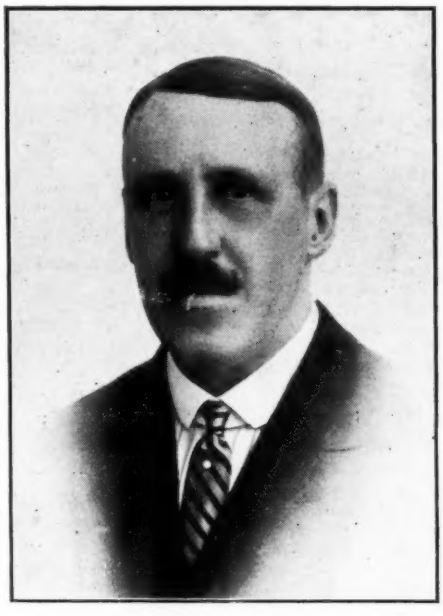
ANNUAL CONFERENCE AT MANCHESTER.

Civic Welcome.

The twentieth annual general meeting and conference of the Institute was opened on Wednesday, June 13, at the Manchester Municipal College of Technology. The Lord Mayor of Manchester (Councillor W. Cundell, J.P.) attended to welcome the members to the city, and there were also present Mr. J. H. Stubbs, President of the Manchester Engineering Employers' Association, and Mr. J. Porter, President of the National Union of Foundry Trade Workers.

MR. H. L. REASON, the retiring President, occupied the chair at the opening of the proceedings. He said this was the third time the Convention had been held in Manchester, and he was sure all who attended would be pleased with the programme which had been arranged for them by the Lancashire Branch under the guidance of Mr. Stubbs, Mr. Miles, the President, and Mr. Makemson, the Secretary. They were also very pleased that the Lord Mayor of Manchester was with them. (Applause.) They came from all parts of the country to attend these conferences, and when they were received by the Lord Mayor of any large city it considerably enhanced the interest of the Convention. They also appreciated the features of interest offered by the engineering works in the district, because they were engaged in a branch of industry which assisted at the birth of every great engineering enterprise. Mr. Clare Lees, the President of the Manchester Chamber of Commerce, was unfortunately unable to be present, but they were pleased to see Mr. James Porter, the President of the National Union of Foundry Trade Workers. The Institute did not consider wages or hours; its sole ambition was to improve the work of the foundry.

They also had present Mr. J. H. Stubbs, the brother of the President-Elect, and the President of the Manchester Engineering Employers' Association. It was not necessary to give him information as to the value of the work the Institute was doing.



MR. OLIVER STUBBS,
President of the Institute of British Foundrymen.

Mr. Stubbs is joint managing director of Messrs. Joseph Stubbs, Limited, Mill Street Works, Ancoats, Manchester, one of the best known of textile engineers and ironfounders in England. Their product ranges from a few ounces up to 10 tons. Mr. Stubbs has been the President of the National Ironfounders Employers' Federation since its inception eight years ago. Mr. Stubbs was President of the Institute of British Foundrymen in 1921 and 1922, and his first year of office was commemorated by the donation of the "Oliver Stubbs" Medal.

THE LORD MAYOR said it afforded him much pleasure to extend to the members, in the name of the city, a very hearty welcome. In his opinion, they could not have come to a better place. From the engineering point of view, it was one of the best centres in the North of England. But perhaps they knew more about that than he did himself. No doubt they would visit many of the local firms and see things of interest; he would not venture to say it would be an educational experience, because he realised that he was addressing experts in the mysteries of science, and it was questionable whether Manchester could teach them anything. He was quite sure, however, that they would have a very warm welcome. Unfortunately, trade was not good at the moment, and they would not see all those hives of industry at work; it would have been a real pleasure to the citizens as well as to the visitors if that could have been the case. It was interesting to learn that they had with them the President of the National Union of Foundry Trade Workers. That told him at once that they were on very good terms with the Unions, which was a very great thing to say in these days. They had all lived long enough to know what strikes were. In the Manchester Corporation they, unfortunately, had disputes with the men employed in various trades, and from experience he could say it was much better for employers and men to sit round a table and thresh out matters thoroughly, and then come to an equitable understanding. He hoped they would take away with them from Manchester very pleasant memories of their visit and that the results of their deliberations would be of the greatest possible service to the Institute and the very important industry they represented. (Applause.)

Presentation of the "Oliver Stubbs" Medal.

MR. HOLLINWORTH, the General Secretary, read out the grounds on which the "Oliver Stubbs" Gold Medal was awarded to Mr. W. H. Sherburn, of Warrington. These grounds were the Paper on "The Evolution of the Foundryman," read by Mr. Sherburn at the January meeting of the Lancashire Branch, and meritorious services rendered to the Institute from its inception, as well as for example and precepts given to the members of the Institute and the industry in general.

THE LORD MAYOR, in making the presentation, remarked that he gathered that Mr. Sherburn had been instrumental in forwarding the work of the Institute. It was very creditable, and it must be very gratifying to his colleagues that they had this opportunity of showing their appreciation.

MR. SHERBURN said he appreciated the honour which had been done to him by the Lancashire Branch and the Institute. The services he had given to the Institute he gave in obedience to the inward "must" which every foundryman must feel if he had got the foundryman's blood in his veins and had the interests of the industry at heart. He took his honour as having been given to him not as a recognition of his own work alone, but also of the work done by the Lancashire Branch for the Institute. Had he been alone he could not have done much, but he had been supported by a splendid lot of fellows on the Lancashire Branch, as he believed there was in every other Branch. He was proud of receiving the medal because it would keep in his memory the name of Stubbs, honoured as it was in Lancashire; he was also proud of it because it was a recognition of his point of view. The Institute had among its members a fine array of scientists, and a fine array of practical men; he himself had tried to emphasise the human side. There was only one

little thing to cause him dissatisfaction; that was that the "Oliver Stubbs" medal did not come a few years earlier. It had got a little leeway to make up. There were other members who deserved it, and he hoped to live to see at least a dozen of them, most of whom were present, receive the like honour.

MR. R. BUCHANAN, in moving a vote of thanks to the Lord Mayor, said it was with somewhat mingled feelings that he recalled the first Conference held in Manchester, over which he presided. He had some misgivings as to what would be the outcome, and when it ended he was overwhelmed with gratitude at the result. The Institute started with eight or nine members; it had now over 1,600. That was a really wonderful record when one considered the conservatism which was so deeply rooted in the foundryman. It gave them encouragement to know that the civic powers were interested in them and in their educative mission.

The motion was carried unanimously.

General Meeting.

The general business meeting was then begun, Mr. Reason presiding. MR. HOLLINWORTH (the General Secretary) read the minutes of the last annual meeting, which were approved. The report of the General Council and the balance sheet were taken as read, and approved on the motion of MR. O. STUBBS.

ANNUAL REPORT AND BALANCE SHEET.

The General Council have pleasure in presenting to the members their Report of the progress and work of the Institute during the past Session 1922-23.

Four General Council meetings have been held during the Session at Birmingham, Manchester, York and Birmingham respectively. Representatives of the Branches from all parts of the country have attended the meetings, and there has been an average attendance of thirty-five.

The respective Branches have the following members attached:—

	Members.	Aesociate Members.	Associates.	Total.
Birmingham ..	54 (47)	88 (96)	17 (20)	159 (163)
Coventry	32 (29)	50 (64)	8 (8)	90 (101)
East Midlands ..	31 (29)	66 (61)	9 (9)	106 (99)
Lancashire ..	96 (85)	161 (139)	4 (3)	261 (227)
London	88 (74)	70 (64)	9 (7)	167 (145)
Newcastle-on-Tyne	87 (85)	105 (108)	66 (30)	258 (223)
Scottish	70 (69)	(291) 291	17 (50)	240 (281)
Sheffield	93 (85)	100 (96)	13 (15)	206 (196)
West Riding of Yorks ..	34 (27)	44 (14)		78 (41)
General	31 (17)	13 (12)		44 (29)
	616 (547)	850 (816)	143 (142)	1609(1505)

The figures in brackets are for the Session 1921-22.

In addition to the figures shown on the previous page, there are three Members twelve Associate Members, and four Associates, whose elections have been confirmed and are waiting completion by the respective Branches. Excluding the latter, the total number of members on the Roll of the Institute on April 30, 1923, was 1,609, showing an increase for the Session of 104. The Council regret to have to report that nine deaths have taken place during the year.

Annual Conference, 1923.

This will be held on June 13, 14, and 15 at the College of Technology, Sackville Street, Manchester (Room E17), by the kind permission of the Educational Authorities of the City of Manchester.

"Oliver Stubbs" Gold Medal.

The first medal was awarded to Mr. F. J. Cook at the Birmingham Conference for services rendered by his visit to the Conference of the American Foundrymen's Association held at Rochester last year, and preparing and reading a Paper there on behalf of the Institute entitled "American *versus* British Grey Cast Iron," and also for giving Papers to various Branches of the Institute. It will be remembered that Mr. Cook was President of the Institute during the Session 1908-09, and has done a considerable amount of valuable research work by which the Institute has benefited.

Royal Charter.

In the last year's Report it was mentioned that the sum of £34 18s. 2d. was required to clear off the solicitor's charges, and the members will be pleased to learn that this sum was subscribed before the end of the year, so that the account has been cleared without being a charge on the Institute's funds

The new rules under the Charter have been approved by H.M. Privy Council, and after confirmation at the Conference will be adopted.

Balance Sheet.

The accounts and balance sheet of the Institute are presented herewith:—

INCOME AND EXPENDITURE ACCOUNT, FROM JANUARY 1 TO DECEMBER 31, 1922.

EXPENDITURE.

	£	s.	d.
Postages ..	80	0	2
Printing and Stationery, including Printing of Proceedings ..	438	5	6
Council, Finance and Annual Meeting Expenses	42	13	8
Prizes, Birmingham Exhibition ..	10	10	0
Illuminated Address ..	6	6	0
Branch Expenses—			
Lancashire .. £62 12 2			
Birmingham .. 40 13 3			
Scottish .. 73 4 2			
Sheffield .. 39 17 6			
London .. 27 3 10			
East Midlands .. 20 10 11			
Newcastle .. 97 8 8			
Coventry .. 8 12 6			
West Riding of Yorkshire .. 23 10 2	393	13	2
Audit Fee ..	6	6	0
Incidental Expenses ..	11	12	6
Salaries—Secretary and Staff ..	300	0	0
Rent of Office ..	74	10	6
Depreciation—Furniture, etc. ..	7	7	6
Removal Expenses ..	8	5	11
	1,379	10	11
Balance of Income over Expenditure ..	425	8	11
	£1,804	19	10

INCOME.

	£	s.	d.
Subscriptions Received ..	1,757	12	6
Sale of Proceedings, etc. ..	8	9	0
Interest on War Loan, Cash on Deposit, etc. ..	31	7	2
Rent Received, Heating and Ventilating Engineers ..	6	5	0
Miscellaneous Receipts ..	1	6	8
	£1,804	19	10

THE INSTITUTE OF BRITISH FOUNDRYMEN.
BALANCE SHEET, DECEMBER 31, 1922.

LIABILITIES.

	£	s.	d.
Subscriptions paid in advance ..	80	6	6
Sundry Creditors ..	280	11	4
Royal Charter Fund—			
Balance per last Account .. £56 14 10			
Donations .. 93 11 8			
Less: Payment to Solicitors .. £150 0 0			
Balance transferred to Gen. Account .. 6 6	150	6	6
Surplus at December 31, 1921 .. 539 11 10			
Add: Balance of Royal Charter Fund .. 6 6			
Excess of Income over Expenditure for the year ended December 31, 1922 .. 425 8 11	965	7	3
	£1,326	5	1

ASSETS.

	£	s.	d.
Cash in Hands of Secretaries, etc., viz.:			
Lancashire .. £18 16 0			
Birmingham .. 22 1 4			
Scottish .. 29 0 11			
Sheffield .. 50 7 3			
London .. 33 18 3			
East Midlands .. 18 17 9			
West Riding of Yorkshire .. 15 1 10			
Coventry .. 29 5 3			
£217 8 7			
General Secretary, Petty Cash .. 7 19 8	225	8	3
Lloyds Bank Ltd.—			
General Account .. 171 19 1			
Deposit Account .. 400 0 0	571	19	1
Investment Account—			
£100 5% National War Bonds and £360 5% War Loan at Cost ..	432	10	1
Furniture, Fittings and Fixtures—			
Per last Account .. 73 15 2			
Less: Depreciation, 10% .. 7 7 6	66	7	8
Birmingham Branch—			
Special Advance ..	30	0	0
	£1,326	5	1

We have prepared and audited the above Balance Sheet with the Books and Vouchers of the Institute, and certify same to be in accordance therewith.

J. & A. W. SULLY & CO.,
Chartered Accountants, AUDITORS.

General Council.

The members who retire in accordance with the rules are Messrs. J. Cameron, W. H. Cook, B. Hird, T. W. Markland, and J. G. Robinson. Messrs. Cook and Markland desire not to be re-elected. Messrs. Cameron and Robinson offer themselves for re-election. Five will require to be elected at the Conference to complete the ten members as provided for in the rules.

Standardisation of Test Bars.

The Committee appointed to deal with this subject has been hard at work during the past year, and it is expected that a report will be forthcoming at the Conference. The Council desire to recognise the work of the Committee dealing with this question.

Diplomas.

The Awards Committee has given close attention to the Papers which have been recommended by the Branches for Diplomas, and the Committee's recommendations will be made to the Council and submitted to the Conference.

Past President the Late Mr. Wm. Mayer.

The members would learn with regret of the death in January last of Mr. Mayer, who rendered valuable services to the Institute some years ago and who presented a gold chain and badge to the Institute for the use of the President during his year of office. Mr. Mayer also gave a sum of money to be invested, and for the interest to be used to enable a Gold Medal to be awarded annually in the Scottish and Newcastle Branches to perpetuate the memory of the late Mr. Wm. Surtees.

The British Cast-Iron Research Association.

The Council are pleased to report that this Association, which will always be regarded as owing its inception to our Institute, is progressing. Dr. Longmuir, one of the earliest Presidents, has during the year been appointed the Director of Research. It is also very gratifying to know that Mr. Oliver Stubbs has been elected Vice-Chairman of the Association and that he has been able to accept the Chairmanship of the Executive Committee of Council, the most important section of the organisation of the Association. It is a noteworthy fact that out of 36 members of the Association's Council 23 are members of the Institute, 8 being members of the General Council. The Council are confident that the Association will fulfil all the expectations formed in 1919 when they took part in its promotion. The President (Mr. H. L. Reason) is the appointed delegate for the Institute.

French Exhibition and Congress.

The General Council has had pleasure in accepting the cordial invitation given by the Association Technique de Fonderie to attend the International Exhibition and Congress which will be held in Paris between September 2 and 16 next. An invitation has also been given to and accepted by the American Foundrymen's Association, and a considerable number of their members will accompany our party to Paris. Full particulars of the arrangements will be issued in due course.

H. L. REASON, *President.*
W. G. HOLLINWORTH, *General Secretary.*

Royal Charter and New Rules.

THE PRESIDENT said these Rules had been submitted to the Privy Council and had been adjusted in accordance with their requirements and the Royal Charter. When the members discussed the change of name from "British Foundrymen's Association" they decided, after some debate, to use the word "Institution" and not "Institute." When the lawyers who had the petition for the Royal Charter in hand presented it to the Privy Council, by some means or other they introduced the word "Institute," and the Royal Charter was received under the name of "The Institute of British Foundrymen." Under the circumstances the Council could see no alternative but to adopt the word "Institute," but had deferred the final decision until the matter could be brought before the members. It must be clearly understood that if the alteration was adopted they must abide by what the Charter said, and it would involve a change in future stationery, diplomas and other things; the word used must be "Institute." He felt rather sorry the change had taken place in view of the dies which had been made for striking the "Oliver Stubbs" medal, and the diplomas which had been given. However, he would ask that someone propose that the word "Institute" be adopted, and also the new rules which had been drawn up in connection with the Royal Charter.

MR. R. O. PATTERSON moved that the word "Institute" and the new rules be adopted. The motion was seconded by MR. VICKERS, and carried unanimously.

MR. J. W. ROBINSON.
"No—Not Glaxo."

MR. E. CAREY HILL.
"System is insufficiently studied."

MR. R. A. MILES.
"Have you heard this one?"

MR. W. G. HOLLINWORTH.
The General Secretary.

Presentation to Mr. O. Stubbs.

THE PRESIDENT said he had a very pleasing duty to perform in presenting to Mr. Oliver Stubbs an illuminated address, as a very small taken of the appreciation by the members of the valuable work he did for the Institute during his term of office as President. (Applause.) They all admired the

interest and vim he put into that work. Two things stood out very clearly in connection with it. The first was the medal bearing his name, which he had presented to the Institute. Secondly he had been largely instrumental in securing a number of subscribing firms. He had done excellent propaganda work among the employers. The members of the Institute would agree that the work turned to the advantage of the employers. In doing their utmost to improve the craft and improve its products they were serving the interests of the employers. So the least the employers could do in return was to become subscribing firms. That did not confer any voting power, but it put them in the position of knowing that they were assisting in a great work.

In acknowledging the address, Mr. Stubbs said he should value it highly. He already had in his office one or two similar addresses, and also the certificate of membership of the American Foundrymen's Association. It was something for the juniors to look up to and anticipate the time when they would receive similar acknowledgments of their labours.

Election of the President.

THE PRESIDENT said it was a pleasure to him, and he believed it was to the other members, to propose Mr. Oliver Stubbs as the President of the Institute for the year 1923-24. Mr. Stubbs began his first term of office as President in 1921, at a very trying time; there were railway difficulties and other industrial troubles, and the annual meeting and conference had to be postponed and then held at Blackpool. Many of them had pleasant recollections of the happy time they spent there. But the delay cut out three months of Mr. Stubbs' presidential term. Then, accompanied by Mr. Firth and Mr. Cook, he visited the United States, carrying the good work of the Institute there. So when it appeared that Mr. Jewson did not desire to become the President they decided they could not do better than ask Mr. Stubbs to take the office for the second time.

MR. M. RIDDELL seconded the motion, which was passed unanimously.

Mr. Reason vacated the chair, and MR. STUBBS, entering upon his presidential duties, first thanked the members for the honour conferred upon him. He said it was not his own seeking, but in the circumstances which arose, the decision of Mr. Jewson not to go forward, it was thought better not to upset the order in which the then Junior Vice-President, Mr. Patterson, would succeed to the presidential chair.

The Death of Mr. W. Mayer.

The Institute had suffered a very severe loss in the death of their old friend, Mr. W. Mayer, who was a great supporter of the Institute. It came as a great blow, because they had been anticipating his recovery and presence amongst them. It was fitting that his first act as President should be to ask the members to show their sympathy by rising in their places.

The members rose and stood in silence for a short time.

Welcome to American Visitors.

He desired to give a hearty welcome to their American friends. Mr. H. Cole Estep, indeed, had been here so long that he hardly looked upon him as an American. In Mr. F. H. Lane, of Detroit, they had an American who came of British stock, a highly respected member of the American Foundrymen's Association. They wished him a very happy stay in this country, and hoped he would go back to tell their American friends that they must come to this country to see good foundry practice.

Election of Officers.

THE PRESIDENT proposed the election of Mr. R. O. Patterson as Senior Vice-President. This was seconded by Mr. F. J. Cook, who pointed out that the Newcastle district was not represented in the list of Past Presidents. The Institute would find in Mr. Patterson a very good man. The motion was carried unanimously, and Mr. Patterson thanked the members.

MR. H. L. REASON said for the office of Junior Vice-President he wished to propose Mr. E. H. Broughall, who had done good work for the Institute since its inception. Some time ago he suffered a very serious illness and tendered his resignation from the Council, but was persuaded by Mr. Stubbs to retain his position. He had now almost recovered his normal state of health, and when the time came for him to occupy the Presidential chair he would add to the lustre given to it by his predecessors.

MR. RIDDELL said he particularly wished to have the privilege of seconding this nomination. He first met Mr. Broughall at a meeting of the Birmingham Branch, and found him a severe critic. Mr. Broughall was a man who knew how to stick up for himself, and he would certainly stick up for the Institute.

The motion was carried unanimously.

THE PRESIDENT proposed the re-election of Mr. F. W. Finch as Honorary Treasurer. He stated that Mr. Finch found himself unable to attend, but sent a message to the effect that he was with them in spirit.

MR. R. A. MILES seconded the motion, which was carried unanimously.

THE PRESIDENT explained that when the new rules came into force the election of the General Council would be by ballot. Ballot papers would be sent to all the members, and the result announced at the annual meeting. As the new rules had not been finally adopted till now they must proceed at this meeting according to the old procedure. Mr. Broughall having accepted the office of Junior Vice-President, there were six vacancies to fill and seven candidates had been nominated.

Ballot papers were distributed, and Mr. H. Sherburn and Mr. V. C. Faulkner were appointed to act as scrutineers. The result, which was announced later, was that the following gentlemen were elected:—Messrs. J. Cameron, W. T. Evans, A. Firth, J. Haigh, E. Carey Hill, and J. G. Robinson.

On the motion of MR. REASON, Messrs. R. Buchanan, F. J. Cook and O. Stubbs were elected Trustees, Mr. Stubbs taking the place left vacant by Mr. Mayer's death.

On the motion of THE PRESIDENT, seconded by Mr. Patterson, Messrs. J. & A. W. Sully & Company were re-elected auditors at the same fee as previously.

MR. F. J. COOK proposed that Mr. Broughall be their representative of the Institute on the British Cast Iron Research Association. As Vice-Chairman of that body, he could say that they would be very pleased to welcome Mr. Broughall.

The motion was seconded by MR. MILES and carried unanimously.

Advance Copies of Papers.

MR. A. SUTCLIFFE said members had complained to him that they did not receive advance copies of the papers. They did not think they should be expected to make application for them.

THE PRESIDENT said he did not think the papers could be sent round to every member. The expense would be considerable, and should not be incurred unless the members showed that they wanted it to be done. A member who wanted advance copies could make application for them and they would be sent.

Vote of Thanks.

MR. H. COLE ESTEP moved a vote of thanks to the officers and the members of the General Council for their services to the Institute during the past year.

He put the motion to the meeting and it was carried unanimously.

MR. REASON replied. He said, as Past-President he could say that the Council had worked very hard during the year; they had travelled thousands of miles, and sometimes were away from their own business for two or three days attending to the work of the Institute. As regarded himself, the year had been a very happy one, and he would look back upon it with a good deal of pride and satisfaction. He thanked them all for the support they had given him. Mr. Hollinworth had been through a very trying time, having to do his work as General Secretary, dictate letters and so forth, from his bed. This year he had been saddled with a good deal of the arrangements for the Convention. So they would appreciate the difficulties under which Mr. Hollinworth had laboured.

MR. HOLLINWORTH thanked Mr. Reason for his kindly remarks and the members for their sympathy.

The Presidential Address.

Gentlemen,—When I had the honour of addressing you as President in September, 1921, I referred to the bad times the industry, in conjunction with other industries, was passing through, and we are not through yet. Sometimes we thought we could see the beginning of better trade, but let us hope during my year of office these times will come.

Whilst the foundry industry in general has a fair idea of the objects for which the Institute exists, gained no doubt from reading the papers contributed to it by its members, it is perhaps necessary again to review the question. Basically, as you all know, the Institute was formed to improve the status of the industry by the reading and discussion of practical and technical papers in order that (1) more knowledge would be available for the

MR. FRANK RUSSELL.
"A Refractory Customer."

MR. T. FIRTH.
"Specialisation is essential to foundry progress."

executive, (2) and to provide information of a more elementary character, so that the artisan will take more interest in his work.

Dealing with the former, it is obvious that the furthering of the art of founding tends to improve the quality of castings, and to lower their production costs, thus enabling British foundries better to compete in both home and foreign markets.

To a lesser extent, the second object helps similarly, but it presents the added feature of raising the status of the operative, as it indicates to him the real prospects which his trade holds out for him. It widens his viewpoint, and enables him to take a bigger interest in his work and himself as a citizen.

It should be clearly understood that the Institute of British Foundrymen is unique in its attempt to interest and so educate the actual workmen associated with foundry practice. The real technical education of the foundry worker must be left to the numerous technical schools, because the constant repetition of elementary matters would drive from its ranks the experienced foundryman and so limit progress.

An excellent attempt to overcome any lack of deep technical instruction amongst its adherents has recently been made by the Newcastle Branch, where Messrs. Young, Carmichael, and Rang have been mainly responsible for the formation of a junior section, for which the Branch takes full responsibility. I venture to suggest that it will be no disgrace for any foundryman—ill-instructed technically—to attend the meetings of the juniors, as educational facilities have never been quite so available as at the present moment. I do not want you to understand that the policy of the Institution is to prohibit the reading of what may be termed "Instructional Papers"—that is the expounding of principles which can be obtained from reading text books. Their inclusion in Branch programmes serves the very useful purpose of revision.

From time to time complaints arise that some of the papers presented are of too academical a nature. That is not true of the Institute of British Foundrymen. Unfortunately it is true of some of the kindred associations. The test of such matters is whether an intelligent owner, manager, or foreman can, after spending two or three days at a Conference, return to his works and (1) either try out some experiment suggested, with a view to improving his product, or (2) better understand some phenomenon normally exhibited in his practice.

The Work of the Branches.

From its inception, this Institute has attached the utmost importance to the work of the Branches, and in this way set a lead which older Institutions have thought wise to follow. Recent advices from the States indicate that the American Foundrymen's Association are seriously considering following in our footsteps. It is abundantly clear that if the work of the Branches is of paramount importance so, too, is the choice of the Branch officials, and it is because I attach so much importance to this that I have asked the Lancashire Branch-President—Mr. R. A. Miles—to be with me on the platform to-day, and I think it would be a gracious act on the part of future Presidents to follow this lead.

There is a question which admits of ready solution—that is the procuring of suitable lecturers. Several Branch officers inform me that they have the greatest difficulty in this respect, whilst others affirm that it is only a question of expense which prevents them from lengthening their programmes. The obvious remedy is "Co-operation." As one of the chief principles underlying the award of the "Oliver Stubbs' Medal" is "work done" during the year for which it is to be awarded, and a second is the general services rendered to the Institute over a period, these conditions should result in the more active co-operation of prominent members.

I desire to point out that Branch Councils are too prone to work on generally-accepted principles, which, whilst almost invariably excellent, sometimes lead to unfortunate results. An outstanding case of this recently came to light, when no less than three Branches sent in irregular nominations for the "Oliver Stubbs" medal. Other aspects will be touched upon later.

A word has crept into the organisation of the Institute which was never meant by the originator of that particular phase—I refer to the sending of representatives from the Branches to the General Council. Several years ago it was found that a Council meeting held in any particular centre merely expressed the sentiments of that particular Branch, and it was thought wise to have increased representation from the Branches. By some unknown means, these representatives have been christened "delegates," an interpretation never intended by its prime mover, Mr. Riddell. The

MR. T. MAKEMSON.
"It is time the apprenticeship question was tackled nationally."

MR. E. H. BROUGHALL.
"Denseners—not Chills."

word "delegate" admits of an interpretation of a limiting character, which "representative" does not.

It is now 19 years since the formation of the Institute, and though it is, at the moment, tackling problems which affect it fundamentally, I believe that as trade improves they will admit of easy solution. I refer especially to the subscription required for the Associate grade of membership. It should be remembered that the impelling force which has not only kept the Institute together, but has also been the chief instrument of progress shown, is that to which I alluded earlier, namely,

the *improvement in the status of the foundryman.* If we are to lower the subscription rates to a figure materially below those asked by the engineering societies catering for other branches of engineering, it will brand us as being of lower status. It is useless to expect that in years to come everybody who works in a foundry will become directly associated with us, but we do confidentially expect that the cream of the foundry world will identify themselves with us. I have the greatest sympathy with those who, through no fault of their own, are not members because of their financial position, or worse still, have to relinquish membership from this cause. However, we are not officially a charitable organisation, but I can definitely state that unofficially a great deal is done in this direction. There are dozens of members who give much more than the ordinary subscription. For instance, one London foundry foreman has spent no less than £350 out of his own pocket on the general good of the Institute. Whilst, no doubt, a certain gain in membership would be shown by a lowering of the subscription rate for all or any grades of membership, it is not at all certain that the foundryman would receive that enhanced status which he values so much.

Research.

During the past year, naturally, changes have taken place in the personnel of the British Cast Iron Research Association—an organisation which has for its object the co-operative provision of data by which British foundrymen are to increase the quality of their work at less cost. Associated with this is the solving of difficulties as they arise. Such work, whilst of basic interest to us as foundrymen, is obviously beyond the scope of the Institute, but the mutuality of interests exhibited on the inception of the Association has this year been cemented by the appointment of Dr. Longmuir as Director of Research, Mr. F. J. Cook, Chairman of the Research Committee, whilst I have the honour to preside over the Executive Committee, all three being Past-Presidents of the Institute. It will be noticed that I have stressed the provision of data as the prime object of the Association, because such work is national in character, whereas the solving of a temporary difficulty is but local. It is customary to call the former "fundamental research," and when such work, if presented in understandable language by those who are really in touch with works conditions, it is of inestimable value. If, as has happened in other industries, it is so obstruse as to prevent its ready interpretation by those in charge of manufacturing processes, then "fundamental research" can assume an aspect of wasting ratepayers' money for the purpose of providing jobs for research workers. In Dr. Longmuir the foundry industry is extremely fortunate, for he has "risen from the floor" in more senses than one, and obviously realises to what extent the average intelligent foundry executive can apply advanced technology.

I saw only last week an article in THE FOUNDRY TRADE JOURNAL in which a German professor outlined the properties of pearlite in cast iron, which strikes to the very heart of grey-iron foundry practice. This material may or may not show novelty, but it does show that the Germans are prosecuting research work in a very thorough and interesting manner, and this in spite of their supposed lack of money. The progress which the Americans have made in the manufacture of malleable, because of their research organisations, is now not merely a matter of history, but a serious factor in commerce. For instance, the French railway companies are specifying "American malleable cast iron." Obviously research cannot be carried on without money, and I appeal to members to accord to the Association the same hearty support which they have invariably given to the Institute.

Commercialising the Institute.

For several years much time in council has been devoted to the consideration of applications for membership by those more directly concerned in selling material to foundries than in the control of or participation in foundry processes. In the past some of the former have been received, and with remarkably few exceptions have worthily upheld the traditions of the Institute, but in the future, unless an applicant can show that he is *at the time of his application* doing work, practically or technically, in the making of castings or improving of foundry practice, and not mainly engaged in foundry supplies, then he is not eligible. It is to be regretted that this action is thought necessary, but we must keep to the spirit upon which we based our application for the Royal Charter. A definite ruling is to be sent to all Branch Councils, and it is to be hoped that this will effectually prevent members from putting forward any unqualified person. To those supply-people who are amongst us, we know from personal acquaintanceship that they can be counted upon to do everything in their power to help us along, and will continue to refrain from any commercial exploitation.

THE FOUNDRY TRADE JOURNAL, the official organ of the Institute, this year reached its majority. It started just three years before the Institute, and was the means of its incorporation. Since that time it has consistently done everything possible to further our efforts, but at no time has it extended more efficient and close collaboration than since Mr. Faulkner has been its Editor. On your behalf and my own I tender the proprietors my congratulations on having done 21 years of sterling work for the Institute and foundry trade in general

International Relationship.

You will remember that during my previous term of office, I, together with two of your Past-Presidents, Messrs. Firth and Cook, visited the United States. On this occasion we were received on a princely scale. It was here that the spirit of international foundry technical co-operation was conceived. At the Birmingham Conference, last year, further conversations took place between the British, American, French and Belgian representatives with the result that next September the first truly International Foundry Congress is to be held in Paris. The full programme has been prepared, and anybody particularly interested will be able to inspect the full itinerary before the close of this Conference, and in any case, they will be circularised before many days have passed, as this idea of international co-operation is one to which I have devoted a good deal of time and energy, I sincerely trust that as many as possible of you gentlemen will take advantage of the facilities afforded by the Paris Convention. It is useless for any nationality to imagine that they have a monopoly of all that is best in foundry practice, and I feel convinced that the Paris Convention will show us that there are many things which we can learn from our French friends.

Conclusion.

Even as President, I find it distinctly difficult to visualise the complex requirements of the foundry trade and the Institute, but I would ask you in your branches carefully to consider any steps which you propose taking in its national aspect, because I can assure you, gentlemen, that any comprehensive tour of the branches cannot help but convince one of the totally different conditions which obtain. Some branches in their discussions treat questions entirely from the metallurgical standpoint, whilst others are essentially practical in character. These discussions in some measure reflect the type of membership in the branch. Such conditions make it extremely difficult for those directing the policy of the Institute, so to formulate rules which may be nationally acceptable. I therefore ask you, gentlemen, to bear this in mind when considering any innovation.

The main plank in our policy still remains the raising of the status of the foundryman (in the broadest sense of the word) by stimulating his interest in the technical and practical principles underlying his craft. On this we are unanimous, but how it is best to be accomplished must be left in the hands of your Council, and I assert in no indefinite manner that it would be difficult to find a more sincere and unselfish body of men who have the platitudes I have expressed uppermost in their minds.

Finally, I thank you for the honour you have given me by again electing me as your President and for listening with such patience to an expression of views on a few subjects which might be thought to be of a contentious nature.

During my year of office I have the advantage of knowing in advance that I can count upon the cordial support of every member.

XUM

The Manufacture of Steel Castings and Preparation of Sand.*

By F. A. Melmoth, Member (London).

For the purposes of this Paper, it is intended to deal only with steel castings which may be described as of light and medium weight, and the description of processes, details of manufacture, test of results, etc., must be taken as applicable only to castings of this type.

During the past few years the demand made upon the manufacturer of steel castings of this type has been one of consistently increasing severity.

There has been an increasing tendency to replace parts previously made in malleable with steel castings, also, in many instances, in the author's experience, parts heretofore produced as forgings have been, partly owing to the general improvement in steel castings, and probably partly for the sake of cheapness, demanded as castings. It consequently follows that an increasingly large proportion of the foundry output has become subject to an inspection of a very rigid nature, and soundness and perfect machining qualities allied to a good external appearance have become essentials. The Paper now submitted to members is an attempt to describe rapidly the various operations involved in the production of such castings in large quantities.

*A Paper presented to the Manchester Conference of the Institute of British Foundrymen.

METAL PRODUCTION.

Crucible.

Before the introduction of the electric furnace quite a large quantity of light castings was made from crucible steel. One of the works with which the author is associated began its career many years ago as a crucible steel foundry, and samples of its production at that time have comparatively recently been seen by the author.

Plumbago pots were used, and Swedish bar iron was the material melted, and there is no doubt that an admirable quality of metal was produced for light castings. Such dead soft material, however, is extremely difficult to melt; and also the product is liable to considerable variations in carbon content. These two drawbacks, coupled with high melting-costs and the advance which has taken place in the efficiency and knowledge of working of other types of melting apparatus, have caused the almost complete disuse of the crucible for this class of work. Where only a few castings are wanted, or in the case of a firm requiring odd lots of small castings for its own use, of a class

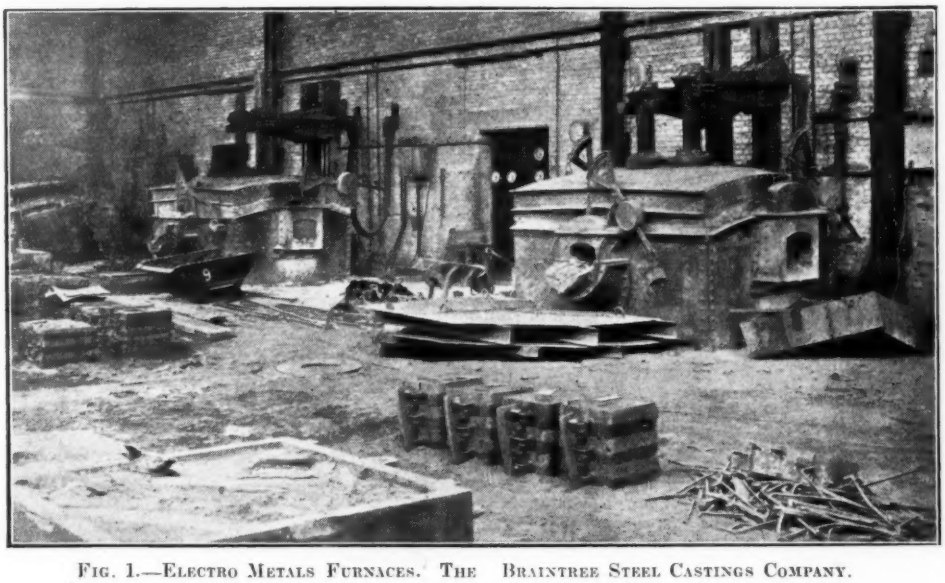


FIG. 1.—ELECTRO METALS FURNACES. THE BRAINTREE STEEL CASTINGS COMPANY.

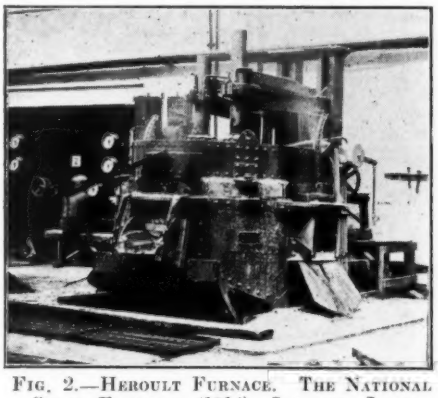


FIG. 2.—HEROULT FURNACE. THE NATIONAL STEEL FOUNDRY (1914), LIMITED, LEVEN, N.B.

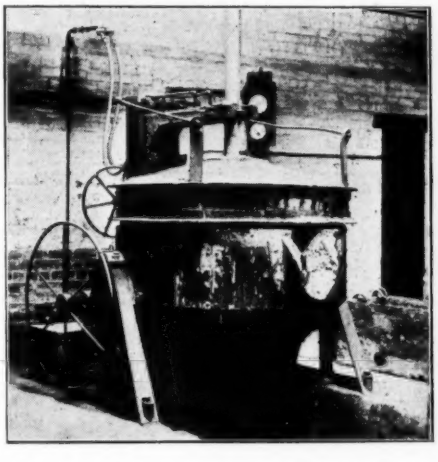


FIG. 3.—SNYDER FURNACE. THE NATIONAL STEEL FOUNDRY (1914), LIMITED, LEVEN, N.B.

difficult to obtain from the production foundries, it may be worth while to use the crucible furnace for the purpose; but as a commercial proposition the success of a foundry relying on crucible melted steel would be, to say the least, dubious.

Converter.

Several types of this furnace exist, the basis principle being the same in all cases, and without doubt this type of furnace represents a most thoroughly tested and satisfactory means of producing steel for light and medium castings. The principle involved is the application of a stream of air to molten cupola-metal, either impinging upon the surface, as in the side-blown converter, or blown directly through the metal as in bottom-blown practice. This results in the combustion of the carbon, silicon and manganese of the molten

FIG. 4.—MACHINE-MOULDED STEEL CASTINGS.

iron, and the consequent production of a very high temperature. To the blown metal, which contains mere traces of carbon, silicon, and manganese, finishing alloys such as ferro-silicon, ferro-manganese or spiegeleisen, are added in the necessary quantity to produce the desired analysis, and, properly controlled, the resulting metal is a steel of consistently high and regular quality, sufficiently hot to run the thinnest sections usually demanded. In almost all cases converters in this country are acid-lined, that is, lined with material of a silicious nature, the basic, or dolomite-lined converter seemingly having never found much favour. It follows, therefore, that no reduction of the impurities, sulphur and phosphorus, takes place, but rather an *increase*, in the former from the coke used in the cupola, and in the latter owing to bath concentration. Obviously, therefore, a pig-iron having a high degree of purity in these elements is an essential to regular practice.

The Stock converter is designed for oil melting

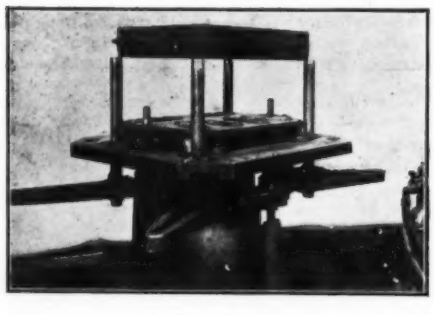


FIG. 5.—JOLT-RAM PIN LIFT MOULDING MACHINE.

in the converter itself, and thus obviates the use of a cupola with its inevitable increase in sulphur content.

The molten iron is afterwards blown and finished in the usual way. For light castings a small converter of this type produces a very suitable steel, high temperature and fluidity being marked features.

Electric Furnaces.

A marked step forward took place in the efficiency of these furnaces in the two or three years prior to and during the war.

Shortage of pig-iron owing to enormous war production demands, the production of vast quantities of scrap material in the form of steel turnings, turned the attention of manufacturers to the electric furnace as a quick, easily-controlled, and very accurate means of steel production, and many steel foundries installed them. Several quite satisfactory types of this furnace are in constant use for the production of steel for steel castings, and given a cheap supply of electricity in the necessary quantity, there is no doubt of their success for the purpose.

Both acid- and basic-lined furnaces are in use, the latter being the more popular owing to the fact of their ability to refine materials high in sulphur and phosphorus. These deleterious elements are removed to almost traces with the greatest ease. One of the greatest advantages of the basic-lined electric furnace is the regularity of composition of the product, due attention to slag conditions producing compositions almost exactly to calculation, with what amounts to clockwork regularity.

The acid-lined furnace is, however, quite satisfactory assuming that scrap of a known degree of purity can be obtained, this furnace being unable to be used for refining purposes.

Fluidity of Electric Steel.

The question of fluidity is one of very great importance to the manufacturer of light steel castings, and during the past year or so much discussion has taken place regarding the relative fluidity of electrically produced, and converter steels. If converter steels are compared in terms of fluidity with the ultra-dead electric steel, produced under a highly-basic strongly-reducing slag, the author is definitely of the opinion that the converter steel

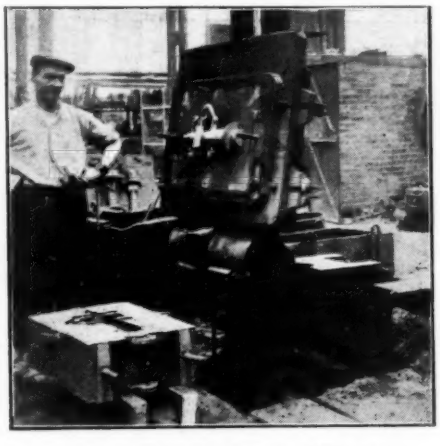


FIG. 6.—JOLT-RAM TURNOVER MOULDING MACHINE.

is the more fluid. This has been stated to be due to various causes, the most usual one being the assumed presence of oxides.

It has been stated that the longer "life" of converter steel is due to incomplete reactions between the finishing alloys and dissolved oxides, these reactions continuing with the production of heat during the casting of the metal. The author would only say that he has never been able to find differences of analysis at the beginning and ending of a cast of converter steel, properly made, of an amplitude sufficient to suggest that any appreciable amounts of silicon and manganese were oxidised and passed to the slag during casting. This, in spite of the fact that, on small castings, it may take close upon thirty minutes to dispose of 30 cwts. of metal.

In contradistinction the author believes that Dr. W. H. Hatfield has stated in discussion that in properly made steel no free oxide can exist. It is assumed, therefore, given constant composition in the orthodox steel-making sense, that fluidity is merely a function of temperature. In the author's own experience in the production of soft steels for light castings a marked difference does not only exist between converter and electric steels made under a strongly reducing slag, but also between what is known as single-slag and double-slag electric furnaces charges. As is well known, single slag charges are never subjected to such a highly reducing slag action as are those in which the first slag is removed, and a new one made for finishing purposes where refining is

requisite. The author has seen many charges which have been subjected to refining slags for a longer period than normal, which have been so hot that the furnace has been badly damaged, and the stopper in the ladle quite unable to withstand the temperature, which, when hand shanked, have not "lived" by any means so long as a single slagged charge made in a perfectly normal manner and of average apparent temperature. In his opinion, only a reliable means of regularly ascertaining molten-steel temperatures, not on a single charge, but over a prolonged period, together with the evolution of a really reliable method of estimating oxygen, or rather the oxides, in steel, can throw any true light on the problem. In its present state the matter stops at assumption based on observed phenomena.

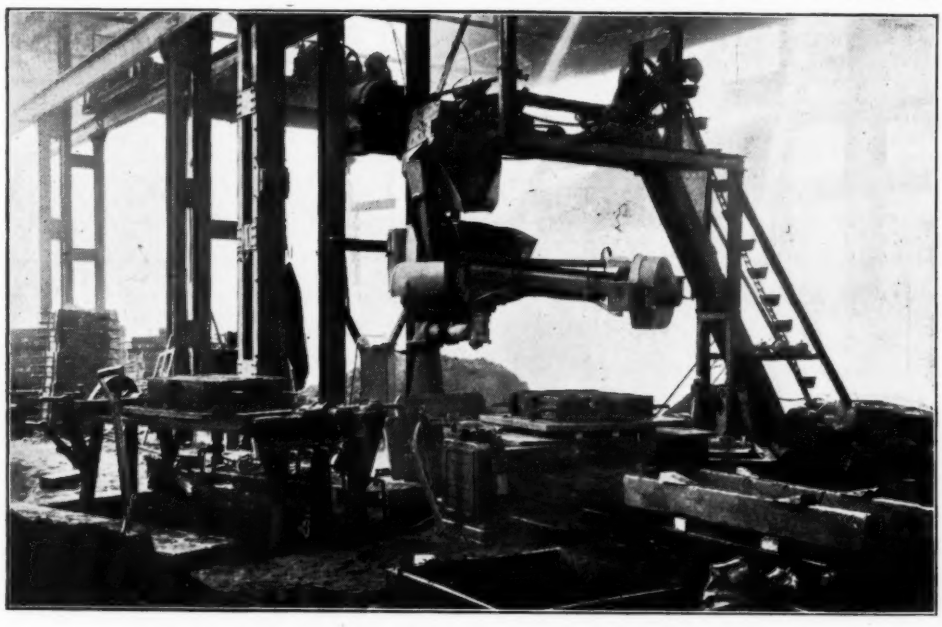


FIG. 7.—THE BEARDSLEY PIPER SAND SLINGER—STATIONARY TYPE.
(BRAINTREE STEEL CASTINGS COMPANY.)

Composition of Metal.

The most common physical specifications for carbon steel castings are as follows:—(1) 26 to 35 tons tensile per sq. in., 15 to 20 per cent. elongation. (2) 35 to 40 tons tensile per sq. in., 10 to 14 per cent. elongation.

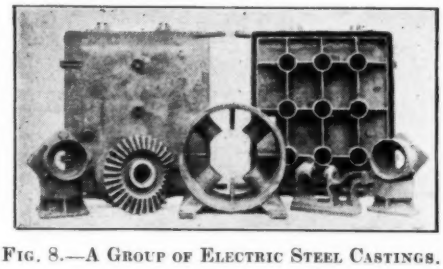


FIG. 8.—A GROUP OF ELECTRIC STEEL CASTINGS.

These are easily met by steels of the following compositions, given normal heat treatment.

	(1)	(2)
C.C.	0.18 to 0.23	0.30 to 0.35
Si	0.25 to 0.30	0.20 to 0.25
Mn	0.70 to 0.90	0.70 to 0.90
S. & P.	under 0.06	under 0.06

Sulphur and Phosphorus in Steel Castings.

The influence of sulphur and phosphorus has, in the author's opinion, been somewhat exaggerated from the standpoint of their effect in causing defects in steel castings, many cases having come to his notice where these impurities have been blamed for cracks in castings, which on consideration could be definitely assigned to neglect during moulding to provide means of easy contraction of the casting whilst cooling. There is no doubt that an excess of sulphur is liable to make mild steels cast into sand moulds less able to resist the stresses to which castings are subjected during solidification and after cooling.

In the author's experience, however, large numbers of intricate castings made from steel containing 0.06 to 0.08 per cent. sulphur, have given not the slightest difficulty in this direction, assuming design to be reasonable, and the necessary care taken during moulding and coremaking.

The effect of phosphorus in excessive quantities is more liable to be shown whilst the casting is in service, its tendency being to reduce the resistance of a casting to repeated shocks.

This appears to be the case regardless of the fact that such steels, say, containing 0.10 per cent. or more of phosphorus, show no signs of inferiority under the ordinary tests to which castings are subjected, the tensile and elongation capabilities of the metal being almost, if not quite, as good as in the case of steels containing mere traces of phosphorus. Given an upper limit of 0.06 per cent., however, no trouble need be anticipated.

Their freedom from sulphur and phosphorus has often been given as the reason for electric steels giving a higher standard of performance under test, than the average converter steel of similar composition. It is the author's opinion, however, that more probably the reason is the freedom of the electric steel from non-metallic inclusions, and its susceptibility to heat treatment.

The "as-cast" structure of an electric steel has always appeared to the author to be more easily removed by heat treatment than that of converter steel of similar analysis.

Influence of Aluminium.

The use of aluminium in reasonable quantities is beneficial, and indeed essential to the production of steel castings. Any large excess, however, is very deleterious. In an experiment carried out by the author, comparisons of results obtained on test bars attached to steel castings dosed with varying quantities of aluminium, showed that excessive amounts lowered maximum stress, yield point and elongation, and decidedly reduced the capacity of the material to resist shock.

Carbon-free ferro-titanum has been used as a final deoxidiser, the result found being a small but regular increase in the tensile strength.

With electrically-produced steels, however, this material is not a necessity.

Mould Production.

The vast majority of steel castings of the type herein dealt with, is produced by machines. Under

the present conditions of low prices, and severe competition for every order available, it is no longer possible to produce such moulds economically by hand, except in certain highly specialised cases. Where of special intricacy or in cases where diffiulties of design or a multiplicity of loose pieces make machine moulding inadvisable, it is the practice in the author's works to use oddsides.

The material of which the oddside is made naturally depends upon the number of moulds to be produced from it, and in these works plaster or wood is generally used. For many small parts, particularly the smaller types of chassis castings, in which design, from the point of view of rapid production, is not always all it might be, this has been found to be quite an economical method.

Whenever possible, however, patterns are mounted on metal plates or boards for production on some type of moulding machine. The squeezer, jolt-ram pin-lift, jolt-ram turnover types of machines are in constant use for such work, but the author's preference for small work is for the jolt-ram pin-lift type.

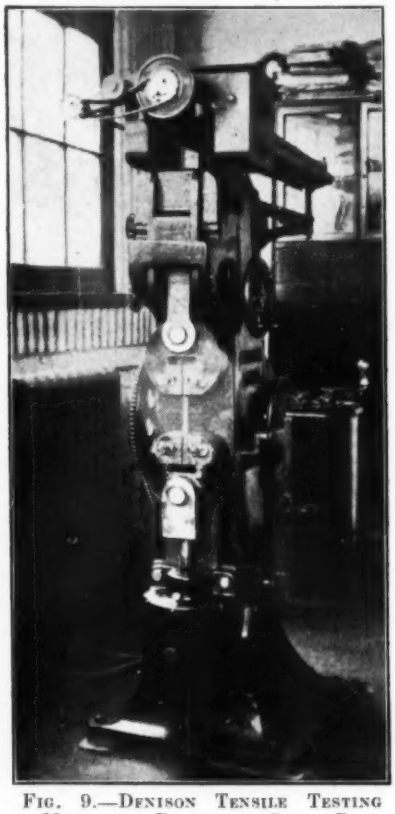


Fig. 9.—Denison Tensile Testing Machine. Braintree Steel Castings Company.

For a larger class of casting, probably involving more intricacy, and a greater depth of draw, the best results have been obtained from jolt-ram turnover machines with pattern drawing attachments. Unskilled labour can be very quickly trained to handle these machines, and when properly equipped with good boxes and well-made patterns, preferably of metal, the output of moulds is very large.

At the same time the casting produced is almost always of better finish, and more true to pattern, than is the case when hand moulded.

The main point to be considered in machine moulding is the adequate supply of satisfactory tackle. First-class boxes machined on the joint, and bushed with hard bushes, case-hardened locating-pins on the pattern-plate, and case-hardened closing pins have been found, along with well finished metal patterns, to be *essentials*, if the full benefits of machine production are to be attained.

A comparatively recent innovation in machine moulding is the Beardsley Piper sand slinger. The author has recently had the opportunity of observing this machine over a fair period, in which it was used for several kinds of work. In this machine, prepared sand is fed into an impeller head by a conveyor belt, and projected at the pattern by means of rapidly revolving blades. The machine is capable of ramming sand at the rate of about 10 cwts. per minute, and undoubtedly represents a marked step forward in the evolution of machine moulding. The question of facing sand represents some little difficulty, as obviously only one type of sand can be handled by the machine, but it is claimed that the ordinary backing sand can be kept in such condition as to be perfectly satisfactory on the face of the mould. The author feels, however, that it is too early to make any very definite statement regarding this machine, but should its claims be fully substantiated, there is no doubt that as a means of producing moulds for castings of a medium weight it will occupy a very prominent position in the future.

The use of machines, of any type, makes a very heavy demand on the core shop, and in order to cope with it, machines to make cores will have to keep step with the advances in moulding machine practice. Both jolt-ram and squeezer machines are in use for this purpose, but the author considers that the attention paid to the machine production of cores is still well behind that paid to machine mould production.

Fig. 10.—B.1 × 50 dias.

Moulding Sands.

The basis of all sand mixtures used for the type of castings here dealt with, is a sharp silica sand, to which various materials are added to give the mixture the necessary plasticity and bonding power to retain its shape in the mould. The outstanding qualifications such a sand-mixture must possess are:—Refractoriness sufficiently high to resist fusion by the stream of extremely hot metal to which it is subjected, the capability of being rammed sufficiently firm to resist the erosive action of the metal, and sufficient plasticity to allow it to be easily worked. In addition it must possess the maximum degree of permeability, to allow of the escape, at the maximum possible speed, of gases evolved during casting. The majority of the castings dealt with in this Paper are cast in green-sand moulds, that is, moulds which are not dried before casting, and owing to the unavoidable presence of considerable amounts of moisture, the question of permeability of the sand is of first grade importance.

Mixtures of sands for green work vary in different foundries, but in the works with which the author is associated, the best results have been obtained from a coarse grade of silica sand, thoroughly milled with a sufficient quantity of sandy loam to give the necessary plasticity. The minimum amount of water should be used, and the amount of bond should be just sufficient to enable a quan-

tity squeezed in the hand to retain its shape, and no more. A mixture so made and rammed efficiently is found to possess the necessary resistance to the stream of metal, whilst possessing adequate permeability to vapour and gases. If too wet, it will be almost certain to ram too hard and close, and become a fruitful source of porous castings.

Grain-size measurements of a suitable silica sand are shown in Table I.:—

TABLE I.—*Details of grain size of sand for steel castings.*

Meshes per sq.in.	120	100	80	60	50	40	30	30*
Per cent. passed through.	0.37	0.34	1.13	2.16	4.98	28.86	30.32	31.84

* Retained on sieve.

To obtain the best results, particularly in small intricate castings, it was at one time considered necessary to use new sand entirely for facing.

Some little time ago, the author carried out a

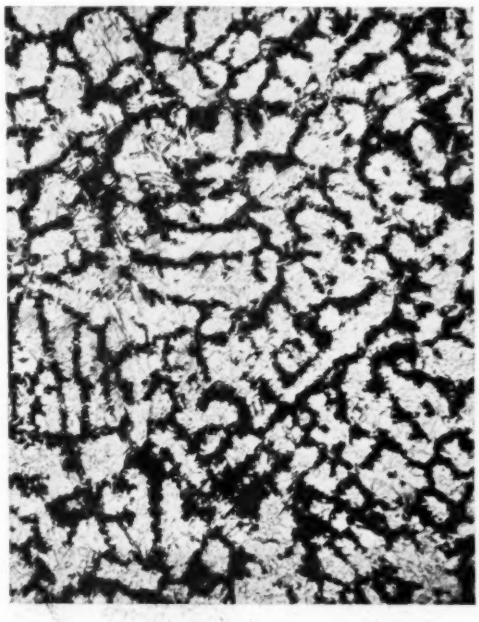


FIG. 11. B.2 × 50 DIAS.

prolonged series of experiments with a view to determining the reasons for the unsatisfactory results obtained from facing sands for such work when old sand was used. It was found that the sand on repeatedly using contained increasing quantities of fine silt, originating, of course, in the clay used as a bond, which silt was very high in alumina. The action being accumulative, the ultimate effect was the almost complete suppression of the permeability of the sand, with obviously fatal results. The removal of this silt in all cases left a sand, which, when mixed with the requisite bonding material gave results in every way equal to new sand. By means of a patented apparatus, the dust is now removed by a current of air, and in these works quite a large proportion of previously-used sand is included in all sand mixtures. The accumulative increase of fine dust in the backing sands, where large quantities of greensand castings are made, has, in the author's experience, been found to be the cause of many cases of mysterious unsoundness. Very often, although great precautions are taken where facing sand is concerned, the backing sand is somewhat ignored, until it is sharply brought to notice by a series of porous castings, for which no metal or excessive moisture explanations are forthcoming. In his opinion, for mild steel castings, particularly of a small nature, the backing sand should be subjected to just as severe a scrutiny and constant testing as the facing sands.

Table II. shows average samples of sands before and after undergoing the aforementioned renovating treatment.

The dangerous portions can be taken to be those passing through sieves of 80 meshes to the inch and finer, and in these terms a comparison is as follows:—(1) New silver sand, 1.36; (2) untreated floor sand, 18.7; and (3) average of six renovated samples, 7.20 per cent.

The renovating process has therefore removed dust and fine particles to the extent of 11.5 per cent. of the total weight of the floor sand treated. It should be noted that all sands were thoroughly dried before passing to the renovating plant.

The Use of Chills.

Opinions, as to the advisability of using chills on steel castings, vary considerably, but it has been the author's experience that judiciously used and due care taken to see that they are perfectly clean, considerable benefits can be derived in certain types of casting. Owing to the high contraction of mild steel, sharp differences of section are very liable to produce difficulty, due to unequal rates of cooling in the mould, and it is common experience to find that the thicker portions, owing to indiscriminate design, are in such positions as to preclude the possibility of feeding heads being attached. In such cases a properly-designed chill offers a way out of the difficulty, and although the author realises that, carelessly used, pulls, and very often unsoundness, results, he has experienced many cases of special design where the use of external, or sometimes internal, chills have proved the only solution.

The Dressing of Castings.

It often appears that this department receives but scanty attention, and in some cases within the author's experience, the dressing shop has represented a veritable bottle neck, becoming a brake of serious import on otherwise well-designed foundry production schemes. Particularly so in the

TABLE II.—*Giving details of the sievings of sand shewing percentage passing through sieves of various meshes.*

Meshes to the inch.

	120	100	80	60	50	40	30	left on 30
(1)	8.6	4.9	5.2	7.4	6.5	24.7	21.8	20.9
(2)	1.13	0.23	trace	1.13	0.91	16.59	43.41	36.6

Samples of treated sand taken from renovating plant.
Meshes to the inch.

Time.	120	100	80	60	50	40	30	Left on 30
10 a.m.	3.86	2.27	0.56	10.45	3.63	25.9	30.68	22.65
12 a.m.	1.36	1.13	0.68	9.09	2.72	20.22	30.0	34.80
2.20 p.m.	1.60	1.60	0.68	8.23	3.86	20.68	32.5	30.85
3.30 p.m.	2.27	1.60	1.13	6.82	3.64	22.95	31.36	30.23
4.30 p.m.	1.36	1.60	0.91	8.00	4.54	23.17	31.13	29.29

(1) Average floor sand for comparison. (2) Average New Silica sand for comparison.

case of the type of castings now considered, which involve considerable work in trimming, it is essential that this department be adequately equipped to handle, quickly and economically, the full output of the foundry.

All steel foundries of anything approaching modern pretensions are fully equipped with shot-blasting plant for the quick and complete removal of sand. Pneumatic chisels, metal cutting saws of various types, grinding machinery and adequate crane provision to ensure quick transport are essentials for the production of steel castings in large quantities. For the removal of risers and runners on castings of a type difficult to handle in saws, oxy-acetylene cutting blow-pipes are very largely used.

In the opinion of the writer great economies in dressing costs still remain to be achieved, by a more complete co-operation between the moulding shop and the dressing shop.

It has unfortunately been his experience that where there have been two methods of running or feeding a casting, equally satisfactory from the

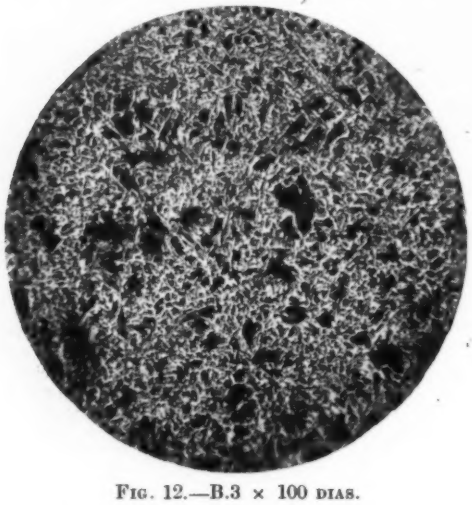


FIG. 12.—B.3 × 100 DIAS.

standpoint of the result obtained, the probability is that the moulder will adopt the one in which detachability in the dressing shop is the more difficult and costly. There is little doubt that if the fettling view point were included always in the consideration of running and feeding problems, it would result in many cases, in a more economical dressing shop expense.

Unfortunate as it is to have to make the admission, a welding plant is an essential requisite. Properly used, and under judicious control, such a plant is capable of considerably reducing the proportion of waster castings. Whilst looking upon it as a necessary evil, for the repair of essentially surface and unimportant defects, which the author has reason to believe occur at least occasionally in all foundries, it should be realised that a correctly made weld possesses almost the strength of the metal of the casting. To say the very least a surface repair by welding is infinitely superior to, if more costly than, one made with the many and varied kinds of stoppings and fillings marketed for the purpose.

Heat Treatment.

In the case of small castings, it was at one time considered possible to dispense with annealing or any form of heat treatment, when the steel used was of a dead soft composition. This belief, it is thought, was, to some extent, fostered by the vendors of electric furnaces.

In a later section the author gives micro-photographs of untreated steel castings, which should be examined in the light of the series of test results on the same samples of material. It is his decided opinion that except in the very rare cases where a casting in service is never subjected to repeated or alternating shocks or to any form of impact shock, heat treatment is an essential. It is also a fact that should a small flaw exist in a casting, a not uncommon occurrence, it will, under service conditions, travel at a much greater speed through the casting and cause fracture, if in the "cast" condition, than if suitably heat treated. There is also the important point to consider that in castings of any degree of intricacy, heavy stresses, due to irregular section, occur in the cooling from the liquid condition in the mould, which stresses remain locked up in the casting and liable on shock or undue stress to release themselves by

FIG. 13.—C.1 × 10 DIAS.

fracture. These stresses are, to a great extent, removed by the reheating of the casting to a suitable temperature followed by a comparatively slow and even cooling. Whilst this removal of internal stresses is of importance, the fundamental of heat treatment is the recrystallisation of the material, the coarse, angular crystallinity being replaced by

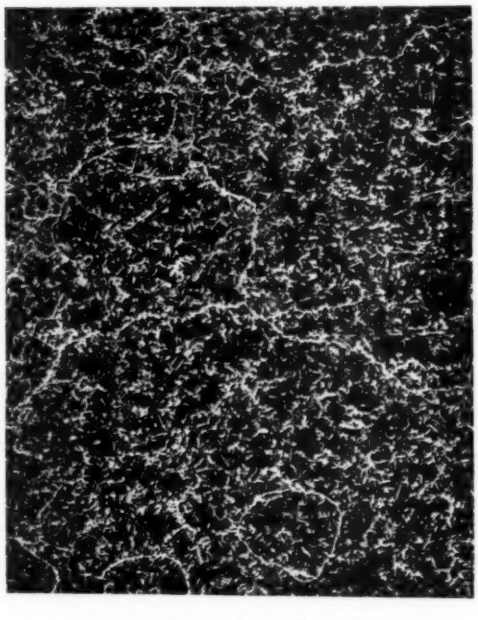


FIG. 14.—C.1 × 50 DIAS.

a fine, close structure entirely free from the strong cleavages and consequent susceptibility to shock fracture of the as-cast condition. In the case of the mild steels commonly used in the production of such castings herein dealt with, this is achieved by heating to a temperature above the upper recalescence point of the steel, say, 880 to 900 deg. C., holding at this temperature for a sufficient period

to ensure the complete solid solution of the coarse ferrite arrangement, and afterwards cooling evenly and slowly. The time obviously depends upon the mass involved, the period being increased with the weight of the casting treated, and the thickness of its section. This is preferably carried out under accurate pyrometric control, and in the case of the examples later given, which were produced, not in a laboratory but in the shop under ordinary commercial conditions, producer gas-fired furnaces were used controlled by a thermo-electric pyrometer. The results given are all of electrically-produced basic-steels, and as previously mentioned whilst dealing with metal production, the author believes such steel to respond much more quickly to equivalent heat treatment than converter steels.

He suggests this may be due to a liability on the part of the latter material to recrystallise during cooling from the heat treatment temperature, along the lines of the pre-existing as cast structure, probably owing to the presence of non-metallic inclusions, which retaining their as-cast form during treatment, afterwards act as nuclei for the precipitation or formation of the ferrite on cooling.

Where castings are called upon to perform specially high duty, it has been found that rather surprisingly good results can be obtained by quenching, either in oil or water, and afterwards subjecting them to a low temperature tempering treatment. Samples A.3, B.3 and C.3 in the Table III., show the results to be obtained by such treatment.

TABLE IV.—*Analyses of Samples.*

Series.	C.C.	Si.	Mn.	S.	P.
A ..	0.16	0.23	0.56	0.012	0.027
B ..	0.23	0.31	0.82	0.008	0.032
C. - ..	0.30	0.38	0.75	0.010	0.026

TABLE III.—*Test Results—Electric Steel Castings.*

Mark.	Heat treatment.	Max. stress tons per sq. in.	Yield pt. tons per sq. in.	Elon. per cent. on 2 in.	Red. of area per cent.	Bending angle 1 in. ∫ ¾ in.	Brinell Number.	Izod Impact foot lbs.
A.1 ..	Nil	28.600	Not discerned.	24	27.7	120 deg. unbroken	138	3.0
A.2	900 deg. C. cooled .. slowly.	28.020	15.932	38	60.6	120 deg. „	131	21.0
A.3	Quenched in water from 900 deg. C. tempered, 45 mins. at 550 deg. C. ..	32.924	21.016	28	40.5	120 deg. „	163	21.5
B.1	Nil	33.98	Not discerned.	17.0	17.8	57 deg. cracked ..	170	1.0
B.2	900 deg. C. cooled .. slowly	32.48	18.26	36.0	53.0	120 deg. unbroken	156	24.0
B.3	Quenched in water from 900 deg. C. tempered, 45 mins. at 550 deg. C.	39.93	27.42	23.0	38.7	76 deg. cracked	196	31.5
C.1	Nil	41.08	Not discerned	9.0	9.5	19 deg. broken	217	Almost nil
C.2	900 deg. C. cooled slowly.	38.17	21.91	28.0	37.2	120 deg. unbroken	187	16.0
C.3	Quenched in water from 900 deg. C. tempered, 45 mins. at 550 deg. C.	47.05	31.25	16.0	22.2	48 deg. broken	228	17.0

DEFECTS IN STEEL CASTINGS.

Under this head the author does not consider it possible in the scope of such a Paper as this, to deal with all the ills to which a steel casting is heir, and consequently proposes only to deal with one or two of the more prominently occurring ones.

Blowholes.

This defect is the most commonly occurring one in steel castings, and may be due to a variety of initial causes, several being connected directly with the metal used, and others being due to the influence on the metal during casting, of factors introduced in the making of the mould or cores. This point has been, in many cases, where control of metal and moulding is under different heads, the subject of discussion which might sometimes easily be termed acrimonious.

From the metal standpoint the presence of blowholes is due to the metal being cast in such a condition as to contain active oxides, which, reacting with the carbon present, produce a gas which is evolved during solidification.

Or, again, the metal may contain other dissolved gases which are evolved from solution as the material crystallises from the fluid condition. In the great bulk of such cases the analysis of the steel for the common steel-making constituents will almost always lead to a defect in the melting practice, which is comparatively easy to correct. Blowholes in cases where metal analysis is satisfactory, however, cannot always be so definitely assigned to a single cause. Excessive quantities of moisture, lack of efficient venting of the mould or core, the use of too fine a sand either as facing or backing, the closing of a partially dried mould whilst warm, with the consequent formation of steam in the mould, and the use of chills, internal or external, in an unfit condition, are all well-known causes which at once occur to mind. It is only, therefore, by a process of elimination applied to one after the other of the possible causes, that the real reason for a case of such unsoundness can be definitely ascertained and a remedy applied. Blowholes in castings occur in two very distinct forms, one in which they are scattered more or less evenly as small holes throughout the entire casting, and one in which they exist as larger cavities, usually to be found in or near thicker portions or in a radius. In the first form it is probable that the metal is at fault, but as excessive moisture in the sand causes defects very similar in appearance, judgment on the matter cannot be too impetuous. In the second form described these holes are very often described as " draws " and the metal defined as " hungry," or as possessing excessive liquid contraction which has caused holes to occur where normally such action does not occur.

In many intricate types of casting, however, the author has noticed that this second type of defect occurs oftener with a low casting temperature, than when the steel is very hot and fluid. He assumes, therefore, that very often cavities described as " draws " are in reality " blows," and are due to the period during which the steel is liquid in the mould, being too short to allow of the escape of certain gases blowing into the metal from (usually) projections in the mould or cores.

Contraction Cracks.

These may be due either to (1) a metal so impure as to be excessively weak immediately after solidification and consequently unable to overcome the resistance offered to its contraction by even the best made mould or core, or (2) sufficient thought not being given during the manufacture of mould or cores, to the need for the least possible resistance to the contraction of the cooling metal.

In the first case the most likely enemy is sulphur, which if present in large quantities (par-

ticularly if manganese percentage is on the low side) causes a definite state of red-shortness.

In the second case (1) too fine a grade of sand or too high a percentage of bonding material causing the mould or core to ram too hard and close, and if dried to consequently bake like a brick; (2) the failure to provide brackets or chills on portions subjected to undue concentration of stresses due to irregular design; (3) the use of such stays in the moulding box as will prevent the free contraction movements of risers, etc; (4) the neglect in certain cases to release the tops as quickly as possible after casting. These are all points for consideration when attempting to elucidate the causes of such cracks.

Draws or Contraction Cavities.

These are inevitably due to lack of proper feeding, either owing to the moulder's shortcomings or to such complication of design that portions requiring feeding are inaccessible. In the former case the remedy is obvious, but the latter, in the author's opinion, occurs with much greater frequency than it should, and calls for still closer co-operation of the designer and foundry.

The Need for Research.

During a considerable period devoted to the consideration of defects in steel castings, the author has been impressed with the general appearance of ambiguity where their initial causes were concerned. Defects of one and the same kind appear to have arisen, possibly from any one of a variety of causes; which state of affairs has been somewhat fostered by the more or less general practice of separate control of mould and metal production. Scientific research applied to the problems associated with the production of the various forms of worked steels, has resulted to a large extent in the elimination of this ambiguity where everyday defects are concerned, and in most cases they can be definitely allotted a cause. The problems of the foundry, however, probably owing

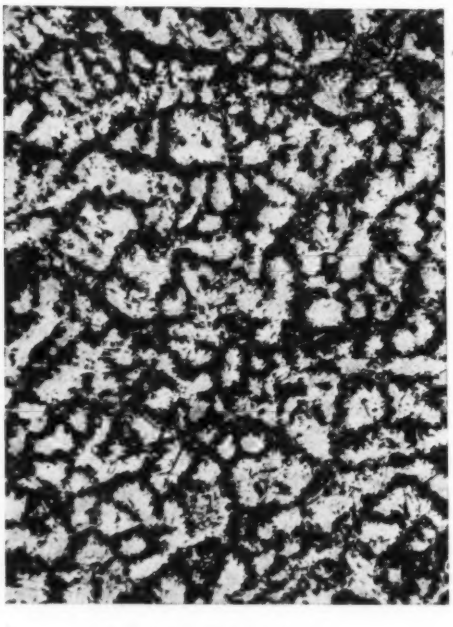


FIG. 15.—C.2 × 50 DIAS.

to the great number of variables which enter into the production of a casting, do not appear to have had, up to the present time, the same scientific investigation, and are consequently very often assigned to some cause or other on a mere visual appearance, which may be grossly misleading.

A prolonged scientifically-controlled investigation into the behaviour of mild steels in sand moulds, and the influence of the various elements on such behaviour, could not help but be of assistance to the steel founder.

Very few steel foundries, however, are in such a position as to be able to afford a full scientific control and the necessary exhaustive investigations. Their only hope, therefore, is in some form of communal research organisation, or in one such as the British Cast-Iron Research Association, which, it is safe to say, is now dealing with the solution of problems in an organised scientific manner, which have existed during the whole history of cast iron, and have often been dealt with previously by rule of thumb, or haphazard assumption.

The author believes he is correct in stating that no such organisation exists where steel castings

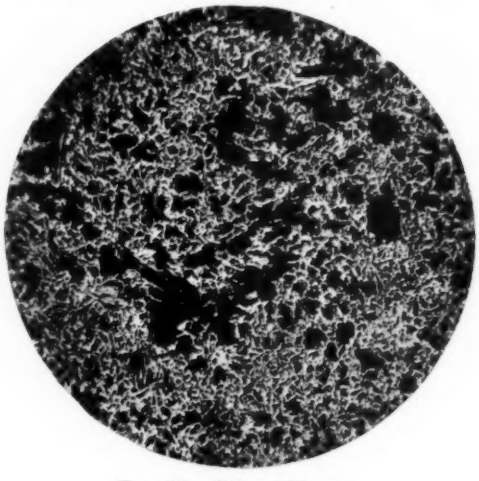


FIG. 16.—C.3 × 100 DIAS.

are concerned, and would suggest that its formation, or the possible future extension of the scope of the above Association to include steel castings, would prove a great boon to the smaller steel founders, who, with every desire to improve their product, are unable to avail themselves of the necessary knowledge and appliances to bring science to their assistance.

The author acknowledges with thanks the facilities granted by the Directors of his Company, the Braintree Castings Company, and also particularly the invaluable assistance with the micro-photographs of Mr. J. H. G. Monypenny, chief metallurgist, Messrs. Brown Bayley's Steel Works, Limited, Sheffield.

Ferro-Silicon in Blasting Explosives.—Occasional use has been made of ferro-silicon in the United States in the manufacture of blasting explosives during the past few years. It is added as a sensitiser and also serves to increase the specific gravity of the powder. —Bulletin 219 of U.S. Bureau of Mines.

Reduction on British Goods entering Canada.—The Ways and Means Committee of the Canadian Dominion House of Commons adopted a resolution on Tuesday last increasing the British Preference by allowing a reduction of 10 per cent. on the amount of the duty paid on British goods entering by a Canadian port.

Iron Production in Norrbotten.—At a meeting of Bruksscieteten recently held at Stockholm the possibility of producing iron in Norrbotten from Lapland ore was discussed. It was pointed out that the construction of new works for producing rolled iron and steel for home consumption would not pay. On the other hand, the opinion was expressed that cheaper pig-iron might be obtained from works situated in Norrbotten.

Detection of Carbon-Monoxide Poisoning.—Through investigations conducted by U.S. Government technologists, methods of detecting carbon-monoxide poisoning have been greatly simplified. For some time the U.S. Bureau of Mines has been conducting research work with the result that means have been found by which it is possible to discover within three minutes the extent to which a person has been affected by carbon monoxide through the extent of poison saturation in the blood. Formerly it took about 24 or 48 hours before diagnosis could be made of such cases either in hospitals or well-equipped laboratories with the services of a skilled organic chemist. The test is now effected through a simple and inexpensive instrument which may be carried in the pocket and which requires no special training for its use.

An Apprenticeship Course in Foundry Practice.—XLVII.

By Ben Shaw and James Edgar.

CALCULATING WEIGHTS OF CASTINGS.

The practice of the patternmaker or moulder calculating the weights of castings is not as common as it used to be. A craftsman may spend many years in workshops without once being called upon to estimate the weight of a casting, from a drawing or a pattern, yet the apprentice should accustom himself to working out the weights and comparing them with the actual weights of the castings after the feeders and risers have been cut off and they are dressed. After a little practice, working on the right lines, it will be found possible to determine the weights to within a pound or two for comparatively small castings.

In large engineering works, and indeed in all works where the work is well planned, the weights of castings are carefully calculated in the drawing office, but in many small shops this is not so. We have known cases where a large job has been cast short because of an error of judgment by the foreman moulder. In most foundries, of course, where many jobs are cast from the same heat of metal, there is no need for a foreman to make other than a very rough calculation of the metal he will require, but there are occasions when the capacity of the cupola is taxed to provide metal for a casting, and in such cases it is imperative that the foreman moulder should have carefully calculated the quantity of metal that will be required.

Need for Estimating Weight.

In the patternshop the weight of a casting may be required, especially if the patternmaker has also been the draughtsman—to determine whether the casting would be too heavy for the purpose required or in order to reduce the weight and consequently the cost. It is exceedingly bad management to send a pattern to the foundry without having previously calculated the weight of the casting. If there is a considerable discrepancy between the estimated weight and the actual weight, close inspection should be made, because at some part the metal must be too thick or too thin. Very few foundries deliberately make castings heavier than they ought to be, but, as every foundryman knows, it is an easy matter to do so, and it has been done many times; therefore, as a matter of plain business, the department which is ordering the castings should adopt this safeguard.

It may be admitted that it is seldom possible to calculate weights exactly, and there are several reasons why this is so. In the first place, unless in shops where methods are thoroughly standardised for quantity production, and the patterns are consequently made of dry, hard timber, which is not much affected by atmospheric or foundry conditions, the thickness of metal is invariably slightly thinner or thicker than is required. In passing, it may be said that in many cylindrical castings which are cored the metal at the top and bottom often differs. Sometimes this is due to careless patternmaking, more often to greater shrinkage occurring on one half of the pattern than of the other, and occasionally owing to a heavy core sagging slightly. There are times also when the core rises. Some of the best moulders, in sheer anxiety to produce good work, card cores more than is necessary, and thus add to the weight.

Good and Bad Patterns.

When good patterns are used on moulding machines or for plate moulding there is practically no difference between the weight of the first castings made and subsequent ones, but this is not so in ordinary hand moulding. A pattern body may swell or shrink sufficiently to make a considerable difference in the resultant casting, or it may warp to such an extent that the moulder has to modify his mould to assure himself of sufficient metal thickness, a procedure which will affect the weight of the casting.

In many cases, also, as with skeleton patterns, the moulder is also a patternmaker, and he cannot be expected to rub corners in every mould of exactly the same radius. There is also the necessity for rapping in order that the pattern may be delivered freely from the sand. Rapping is sometimes overdone by moulders, but on the other hand, when old patterns are being used that are badly distorted, if they are not well rapped, they may tear the sides of the mould. Sometimes old castings are used as patterns, and it is necessary to make up various parts of the mould after the pattern is withdrawn. A mould may not be rammed to uniform hardness, and there are so many different alloys used, especially in brass foundry practice, that it is exceedingly difficult to ascertain the weight of the metal per cub. in. In small castings the variation may be so little as to be quite immaterial, but in large work it may be very considerable. In large work it is not uncommon for a moulder to add extra thickness to flanges and other parts, especially if they are on the top face, and such additions may add appreciably to the weight of comparatively light castings.

These considerations may appear somewhat academic, but it is as well that the apprentice should have a thorough understanding of the various factors which, in a greater or lesser degree, affect the weight of castings. Extreme care in calculating weights in a general jobbing shop, it may be admitted, can but result in what may be termed a near approximation.

Rough Estimate.

Even in patternshops and foundries where men are not required to get out the weights of castings it is a common practice to make rough estimates not based on accurate measurements, and afterwards compare them with the weighing figures. This is a commendable practice, and teaches one a good deal. It may be called rule-of-thumb, but one has to be careful in condemning it as such, because there are long experienced men who will spend a few minutes examining the drawing of a large and intricate design, then consider pattern and coreboxes, and give a weight that is very nearly correct. They attribute their success to practice, but were it possible to analyse the various mental operations performed unconsciously, we should probably decide that their success was due to something more than rule-of-thumb practice. It is really a process of rapid conversion by means of a multiplier. The apprentice at first will probably find that his calculations are far at variance with the correct weight, but he will gradually improve. He will observe metal thicknesses, make rapid calculations of flanges and walls, or he may strike a mean metal thickness and calculate superficial area, and, having obtained the approximate cubic measurement, he can then convert into weight.

Value of Tables.

Success in rough estimating will come more quickly if it is based on a knowledge of mensuration. Indeed, it is impossible to go very far without such knowledge. Mensuration is a most engrossing subject, not exceptionally difficult, and in many ways useful to the foundryman. But even with a good knowledge of this subject, standard tables should be used whenever possible. It is necessary that the student should know how to obtain the area of a circle, but if he wants to calculate the weight of a plain pipe body he will refer to a table of weights of pipes given in one of the several engineers' pocket diaries. He should collect as many of these tables as possible, or at least be able to refer to them quickly. A very useful table, and one which is not commonly known, is of the weights of fillets, which always constitute a big difficulty when getting out weights of castings. This table is only valuable, of course, if the pattern is constructed with fillets. When sharp corners are left—which is undesirable—and

XUM

the moulder has to use his own judgment as to the radius of a fillet, he usually errs on the safe side. In the first place, it is necessary to ascertain the volume of a fillet, and this is obtained by multiplying the area given in the following table by the length of the fillet in inches. The conversion to weight is obtained by again multiplying, this time with the weight per cubic inch of the metal of which the castings is to be made. This for cast iron is 0.26 lb., for steel 0.28 lb., for gunmetal 0.32 lb., for lead 0.41 lb., and for aluminium 0.097 lb.

Radius of Fillet Inches	Area of Fillet Cubic Inches	Radius of Fillet Inches	Area of Fillet Cubic Inch
1/16	0.0008	1 1/4	0.2716
1/8	0.0033	1 1/2	0.3353
3/16	0.0075	1 3/4	0.4056
1/4	0.0134	1 1/2	0.4830
5/16	0.0208	1 1/2	0.5667
3/8	0.0302	1 3/4	0.6573
7/16	0.0410	1 7/8	0.7543
1/2	0.0537	2	0.8584
9/16	0.0678	2 1/8	0.9690
5/8	0.0839	2 1/4	1.0865
11/16	0.0012	2 3/8	1.2106
3/4	0.1207	2 1/2	1.3412
13/16	0.1417	2 5/8	1.4787
7/8	0.1642	2 3/4	1.6230
15/16	1.686	2 7/8	1.7740
1	2.145	3	1.9314

For example, if we have a 1 in. radius round a cylinder 12 in. dia., the length of the radius would first be obtained by multiplying the diameter as follows:—

$12 \times 3.1416 = 37.6992$ in.

Volume of fillet $= 37.6992 \times 2.145 = 80.864814$.

Weight of cast iron = 0.26 lb. per cu. in.,

Therefore, weight of fillet $= 80.864814 \times 0.26 =$ 21.024 lbs.

Weighing Patterns.

A method which has not much to commend it is to weigh the pattern, providing there are no cores, and multiply by a number representing the weight of the metal. Even for patterns which are carved from the solid and on the construction of which no screws, nails or metal dowel plates are used, this is not a satisfactory method, but the apprentice will learn something by making such comparisons, and if the timber is well seasoned he will get an approximately correct result.

The following table is fairly accurate:—

One Pound Weight of Pattern.	Weight of the Casting will be in				
	Cast Iron	Copper	Yellow Brass.	Gunmetal	Alumin'm
White Pine	15.5	18.2	17.5	18	5.41
Yellow Pine	14.6	17.2	16.5	17	5.41
Beech	10.5	12.4	11.9	12.2	3.68
Baywood	13.2	15.5	14.9	15.2	4.60

For example, if the weight of a pattern made in yellow pine is 1.75 lb., then the weight of a casting in cast iron will be $1.75 \times 14.6 = 25.558$ lbs.

Value of Decimals.

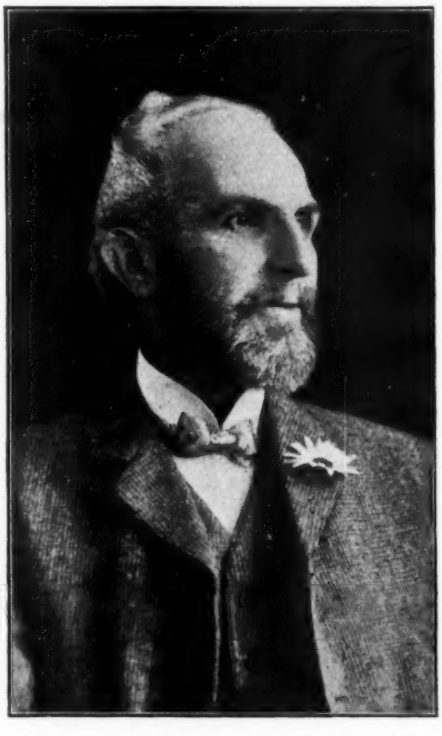
It will be observed that in these examples decimals are used. It is always much more convenient to work in decimals than vulgar fractions, and the apprentice should always convert these into decimals when making calculations. It is rather surprising that so many craftsmen do not know how to solve simple problems by the use of decimals, and yet vulgar fractions are much more troublesome. Those who do use decimals in many cases refer to a table of equivalents when it would be quicker to convert by simple division.

To ascertain the weight of a casting, whether it be intricate or simple, it is necessary to divide it up. Thus in some cases it is convenient to total up the cubic measurements of all flanges, then of branches, etc. When the measurements of each part or set of parts is obtained they can be added together, and the aggregate measurement converted into weight. In the case of castings of exceptionally intricate design judgment has to be used in calculating weights for some parts, but, where possible, measurements should be worked out. It may appear to be slow work to the inexperienced, but it is wonderful how quickly it can be done. If a casting is large, the weight is always given in tons, and if of medinm weight in cwts. Thus, as it is more convenient to calculate in lbs., it is necessary to convert into cwts., or tons, as the case may be. The multiplier 0.009 is approximately correct for converting lbs. into cwts., and the multiplier 0.00045 will convert lbs. into tons.

"Moulders" of the Industry.

No. 5.—MR. W. H. SHERBURN.

Being the recipient of the Oliver Stubbs Medal, Mr. W. H. Sherburn has well qualified as a "moulder of the industry." Mr. Sherburn was born at Rotherham in 1853. He spent many years of his life specialising in the designing and carving of ornamental patterns mainly for fireplaces. After filling positions in Pendleton and Falkirk he finally became associated with the Richmond Gas Stove & Meter Company, Limited.



MR. W. H. SHERBURN, WHO RECENTLY RECEIVED THE "OLIVER STUBBS" MEDAL.

From this firm he partially retired some three years ago, the firm retaining him in a consulting capacity. His colleagues on this occasion expressed their high opinon of Mr. Sherburn by making him the subject of a very handsome presentation.

Mr. Sherburn's connection with the Institution of British Foundrymen commenced in 1905, a year after its inception, when he and seven others met Mr. Finch, still the honorary treasurer, in Manchester, and thus created the first branch. Mr. Sherburn then filled the dual position of Branch-President and Secretary. He has presented a series of Papers, most of which have had for their object the raising of the foundryman's status in the engineering world. That his efforts have been appreciated is shown by the fact that the Institution have awarded him the highest honour a British foundryman can receive—the Oliver Stubbs Medal.

THE NORTHERN UNION ALUMINIUM COMPANY, LIMITED, have removed from 31, Budge Row, London, E.C.4, to Caxton House, Westminster, S.W.1.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.

THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS (MANCHESTER), LIMITED.

BLACKFRIARS, MANCHESTER.

Trade Talk.

THE FEDERATION OF BRITISH INDUSTRIES has been granted a Royal Charter of Incorporation.

THE NORTH BIRMINGHAM IRON & STEEL COMPANY have removed from George Road, Solihull, Warwickshire, to 40, Gravelly Hill North, Erdington, Birmingham.

NOTICES HAVE BEEN POSTED at the Whitehaven Hematite Iron and Steel Company's High House iron-ore mine at Frizington, stating that all employment of labour would terminate as from June 12.

A FIRE OCCURRED on June 11 on the premises of the Primus Stove Company, Steelhouse Lane, Birmingham. The outbreak originated in the basement, but was put out before very serious damage was done.

JAMES & JARRETT, LIMITED, engineers, etc., who have changed the name of the company to W. L. James & Company, Limited, have removed from Salisbury Chambers, Castle Street, to 100, St. Mary Street, Cardiff.

INTIMATION has been made to the Scottish Manufactured Iron Trade Conciliation and Arbitration Board that the average net selling price in March and April was £11 2s. 3.2d. per ton. Wages will be increased by 2½ per cent. on basis rates.

C. A. PARSONS & COMPANY, LIMITED, are supplying the Victoria Falls Power Company, Limited, with three 15,000-kw. turbo-alternators and surface condensing plant, together with one spare alternator, for the Witbank (S.A.) generating station.

E. WEDLAKE-LEWIS & COMPANY, engineers' agents, of 129, Cannon Street, London, E.C.4, have been appointed agents in this country for Visseries & Trefileries Reunies, Soc. An., Division Laminoir, Haren (Nord), Belgium, for the sale of their brass wire.

A FURNACE was put out of blast at Cleator Moor on June 9. The furnaces in blast on the North-West Coast now number 17, being distributed as follows:—Cleator Moor 1, Moss Bay 2, Derwent 3, Oldside 2, Millom 3, Barrow 3, Ulverston 2, and Carnforth 1.

THE STATEMENT that J. R. Houston & Kerr, Limited, engineers and ironfounders, Cartsburn Foundry and Glenburn Engineering Works, Greenock, are compelled to close down for an indefinite period is inaccurate. It is not intended to close down the works, though a lack of orders has necessitated a policy of working on short time. The works are still in operation.

MR. W. H. YARDLEY, hitherto general manager of Princeps & Company, Wentworth Chambers, Pinstone Street, Sheffield, has purchased the business in its entirety from the executors of the late Mr. C. E. Jeffcock. It will be remembered that Mr. Yardley, who took possession on May 26, started the business along with Mr C. E. Jeffcock in 1901, and the company now have extensive connections among the principal collieries, steel works and engine builders in this country, the United States and France.

THE FEDERATION OF BRITISH INDUSTRIES has lodged an application with the Railway Rates Tribunal requesting the Tribunal to order that the Great Western Railway Company reduce its rates on all classes of goods to a flat rate of 33 1-3 above the pre-war charges, the new rate to come into operation on August 1. This will be served upon the Great Western Company immediately, and the company will then be allowed fifteen days in which to lodge an answer. The decision in the Great Western case will probably be honoured by the other companies.

THE CHEMICAL AND TECHNICAL ENGINEERING COMPANY, LIMITED, 11, Pancras Lane, E.C.4, have purchased from Messrs. Corebind, Limited, the rights of manufacture of Corebind, a range of foundry sand-binders which has obtained a high reputation in many of the leading foundries. Corebind is now being made at the company's factory at Hillingdon Heath, Middlesex, of which we hope to give a description in an early issue. It will interest some of our readers to know that the manufacturers are appointing agents and representatives in various districts.

THE NEW MONTHLY ASCERTAINMENT price of Cumberland hematite mixed numbers is £5 15s. 2.48d. per ton, an increase of 5s. 9.41d. over the previous month's price, which was £5 9s. 5.05d. In consequence of this increased price, the wages of Cumberland iron-ore miners (the Cumberland scale not being the same as the Furness scale) will be increased by from 1½d. per day to shift boys, to from 3d. to 6d. per day or shift for men, and for the ensuing month will be as follows (per day or shift in each instance):—Underground Workers: Miners' working bargains, 11s. 3d.; miners' minimum, 8s. 8d.; first-class or leading labourers, 7s. Surface Workers: Winding enginemen, 9s. 8d.; joiners, 9s. 9d. plus 6d. per day tools allowance; chargemen and mineral shot borers, 9s. 9d., plus 3d. per foot; blacksmiths, 9s. 9d.; other workers, increase of 3d., except boys (1½d. increase).

Company News.

Guest, Keen & Nettlefolds, Limited.—Final ordinary dividend of 1s. per share, free of tax, making 10 per cent. for year, free of tax.

A. C. Alexandra & Company, Limited, 10, Iddesleigh House, Caxton Street, Westminster.—Capital £20,000 in £1 shares. Engineers.

Iron and Steel Plant Company, Limited, 1, Western Mail Chambers, Newport, Mon.—Capital £1,000 in £1 shares. Director: J. W. Holmes (managing).

Robertson & Fraser (Glasgow), Limited, 7, West George Street, Glasgow.—Capital £5,000 in £1 shares. Colliery engineers, iron and steel merchants, etc.

Edward Wright & Company (Stourbridge), Limited, Victory Foundry, Stourbridge, Worcs.—Capital £5,000 in £1 shares. Engineers, iron and brass founders, etc.

Fred Ellison & Company, Limited, 96, Harris Street, Bradford.—Capital £1,500. Electrical and mechanical engineers, etc. Directors: F. Ellison and W. H. Ellison.

T. S. Smith & Company, Limited, 129, Steelhouse Lane, Birmingham.—Capital £1,000. Iron, steel and metal merchants. Directors: T. S. Smith (chairman) and A. Turner.

Smith & Company (South Shields), Limited, The Iron Foundry, Nile Street, South Shields.—Capital £10,000. Ironmasters, etc. Directors: E. Smith, J. Smith and R. H. Smith.

George Cawood & Son, Limited, Westgate Foundry, Rotherham.—Capital £2,000 in £1 shares. Ironfounders. Directors: Mary A. Cawood, C. J. Potter, E. F. Darley and A. Pickles.

Carpax Company, Limited, 312, Deansgate, Manchester.—Capital £500 in 490 ordinary shares of £1 and 200 founders' shares of 1s. each. Engineers. Directors: D. S. Paxton and C. K. Curter.

Grace & Childs, Limited, 19, North Church Street, Sheffield.—Capital £6,000 in 5,990 ordinary shares and 10 founders' shares of £1 each. Iron, steel and metal merchants. Directors: T. H. G. Childs (managing), G. L. Grace and W. Lister.

Hatton, Bore & Company, Limited.—Capital £1,000 in £1 shares, to adopt an agreement with H. A. Bore. Manufacturers of iron, steel or metal goods, etc. Directors: F. Mann (chairman), J. Gittins, H. A. Bore (managing) and F. D. Longmore.

Sir W. G. Armstrong, Whitworth & Company, Limited.—Debenture interest, £224,345; available, £467,550; brought forward, £832,091; total available, £1,299,641; two interim dividends, 6d. per share, paid during year; carry forward, £771,516.

John Shaw & Sons (Wolverhampton), Limited.—Profit for two years ended June 30, 1922, £30,846; dividend, 5 per cent., less tax, paid, for 1921; brought forward, £28,476; balance, £50,921; taxation equalisation account, £15,000; dividend, 7½ per cent., less tax, for 1922; carried forward, £23,096.

Gazette.

ALUMINIUM ALLOY PISTONS, LIMITED, have now been finally wound up in voluntary liquidation.

ACME ENGINEERING COMPANY (LONDON), LIMITED, London, W.C.—Mr. A. W. Humphreys, 88-90, Chancery Lane, W.C., incorporated sec., has been appointed receiver.

ALBERTA ENGINEERING COMPANY (1920), LIMITED. Richmond (Surrey).—Mr. J. Day, Abbotsford, St. George's Road, St. Margarets-on-Thames, has been appointed receiver.

UNITED BRASSFOUNDERS AND ENGINEERS, LIMITED (late United Brassfounders and Engineers (1920), Limited), Ormskirk.—Mr. M. W. Jenkinson, 4, Central Buildings, Westminster, has been appointed receiver.

THE SHAREHOLDERS OF THE Palmer Foundry Company, Limited, have decided to wind-up the company voluntarily. Mr. G. W. Roberts, 2, Guildhall Chambers, 31-4, Basinghall Street, London, is the liquidator.

E. F. BURSTON, 166, Goldthorne Hill, Wolverhampton, and J. Whitehouse, Rosewood, Hagley, nr. Stourbridge, trading as Burston, Whitehouse & Company, 7, North Street, Dudley, iron and steel merchants, have been adjudicated bankrupts.

TRADING UNDER THE STYLE of C. Barron & Company, Messrs. H. Barron and C. Clarkson, 16, Craven House, Kingsway, W.C., iron, steel, metals, machinery and plant merchants, have dissolved partnership. Mr. C. H. Barron continues the business.

SIR EDWARD GREEN, engineer, of King's Lynn, Norfolk, who was for several years Conservative M.P. for Wakefield, left £772,548.

Sterling FOUNDRY FLASKS

MADE FROM ROLLED STEEL

LIGHT
ACCURATE
STRONG
DURABLE
RIGID
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STERLING FOUNDRY SPECIALTIES LTD.
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STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

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DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

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BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The outlook in the Cleveland iron trade continues unsatisfactory, and as far as the current quarter is concerned there seems little hope of a change for the better, the recent slackness in buying having occasioned an accumulation of stocks, conditions quite unusual for a long time past in Tees-side makers' yards. The decline in demand for all classes of Cleveland pig is, in fact, more pronounced than ever, the high prices now ruling inducing extreme caution on the part of buyers, both for home consumption and export, which can only be dispelled by a substantial reduction in quotations, at present impossible unless fuel costs can be materially decreased. The latter contingency, unfortunately, must be regarded as remote while export demand for coke continues at its present strength, due, not improbably, to the failure of supplies for Continental consumers. In the conditions thus outlined it is not surprising that markets continue to evidence a weakening tendency, and although nominally prices are unchanged, it is quite understood that any actual business offering could be arranged on slightly shaded terms. Quotations now rule as follow: No. 1, about 127s. 6d.; No. 3 G.M.B., 116s.; No. 4 foundry, 112s. 6d.; and No. 4 forge, 110s

The falling-off in home demand and the stagnation in the Continental inquiry are progressively weakening the hematite position. On Tees-side market this week makers were adhering nominally to 115s. per ton for East Coast mixed numbers, but were inclined to make concessions for any suitable business offering. Business, however, was quiet. West Coast qualities of hematite are also a shade easier, Bessemer mixed numbers now being quoted at £6 5s. per ton, delivered at Glasgow and Sheffield, and at £6 5s. to £6 7s. 6d. for export.

MANCHESTER.—With the general slackness prevailing in the local foundry industry, pig-iron markets in Lancashire are generally stagnant, buying being in most cases restricted to hand-to-mouth quantities. Nominally sellers ask a price based on 105s. at the furnaces for Derbyshire No. 3, and any ironfounder needing a small lot, say 20 to 50 tons, would have to pay this price, but it is an open secret that much less would be accepted for large quantities, and although such a figure was not quoted it is fairly certain that contracts could be placed on a basis of 100s., or, say, about 108s. 6d. per ton delivered in Manchester. This indicates a fall of about 7s. 6d. per ton from the highest prices last month, but it is not nearly enough to induce large consumers to come into the market. The price of Scotch iron is easier also, but there is very little buying and Lancashire consumers say that they simply cannot afford to pay for Scotch. Apparently about £6 9s. 6d. delivered in Manchester is what could be done.

THE MIDLANDS.—In the South Staffordshire area movements in pig-iron disclose a somewhat easier tendency, smelters realising that it is only by conceding lower terms that new business can be attracted. How far they can go in this direction is not yet certain, but evidently consumers are anticipating still lower prices, as they are still holding back contracts. There is a little business passing occasionally for fairly prompt delivery, but it does not appear to be much, and contracts are being worked off very much quicker than new ones are coming forward. Some of the more fortunate makers still have a fair weight of unexecuted contracts and are in no present anxiety, but others are scarcely so well placed, and these latter would not refuse a moderate concession if it were certain to lead to business. Current quotations are: Northamptonshire No. 3 foundry, 102s. 6d.; Derbyshire, No. 3 foundry, 105s. to 107s. 6d.; all net f.o.t. furnaces.

SCOTLAND.—Business in the Glasgow market continues listless, and no improvement in these conditions is anticipated until after the annual holidays, due in the middle of next month. Whether due to want of work or the view that current prices are too high, the fact remains that the buying of pig-iron continues to be on a restricted scale, and unless they can obtain some substantial relief in costs producers will be forced ere long to seriously consider the question of curtailing production. The demand from overseas is very poor, and foreigners, like the home buyers, seem to have no confidence in the future and are content to buy in small lots at intervals. The price of No. 3 foundry to-day for export is £5 18s. 6d., f.a.s. Glasgow.

Finished Iron.

Conditions in the finished iron trade are again reported unsatisfactory, and it is regarded as improbable that any improvement can be effected until a substantial decrease in the cost of production can be assured. There has, consequently, developed some increase in unemployment in South Staffordshire and district, and many manufacturers are finding it difficult to keep mills and forges going. Makers of common bars for such purposes as nut and bolt manufacture not only find demand slack, but also are affected by Continental competition. Such bars are being offered at £8 12s. 6d. delivered South Staffordshire, and, of course, it is impossible for them to come anywhere near that price. Makers of marked bars are, however, less affected, and, so far, have a fair tonnage of orders in hand, having secured some good contracts for wagon and railway material. In Yorkshire makers of bar iron report only moderate business. The reduction of Lancashire crown bars to £12 has not, so far, been followed by any revision by the South Yorkshire Association, which maintained its quotation at £12 10s. Belgian bar iron is being offered at considerably under home prices.

Scrap.

In Lancashire the demand for foundry scrap remains very poor, in spite of the fact that it can be bought at fully 25s. below the price of foundry pig-iron. In most districts there are dealers who have accepted 80s. per ton for good cast scrap, but perhaps the more general price for broken machinery metal is 85s. per ton. There is plenty of good metal in the market, reported to be had at this price; and even for textile machinery scrap dealers will gladly take 90s. Before the war it was customary to sell this class of scrap in Lancashire (where it mostly occurs) at 2s. 6d. to 5s. below the price of Scotch iron; now the difference is just 40s. per ton delivered at a Lancashire station. This fact is eloquent of the condition of the foundry trade. In Scotland the inquiries for cast-iron scrap of all descriptions are practically nil, and it is most difficult to dispose of any parcels. Odd small lots of machinery metal and chairs are being turned over at 95s. to 97s. 6d., and ordinary cast-iron scrap 85s. to 87s. 6d. Light metal and furnace firebars run about 72s. 6d. to 75s.

Metals.

Copper.—Movements in the standard copper market of late have disclosed a somewhat steadier tendency and fluctuations in values, on the whole, have been confined within narrow limits. The margin between standard and fine copper quotations has been further appreciably reduced, and this will probably encourage restocking on a moderate scale. Manufactured copper has been revised all round to a lower level. It was estimated recently the American surplus had been reduced by about 8,000 tons, while the total deliveries for domestic use and export were placed at, roughly, 76,000 tons. Producers seem confident that buying will develop eventually to a good extent for the second half of the year. Current quotations:—*Cash*: Thursday, £68 5s.; Friday, £68; Monday, £67 5s.; Tuesday, £66 12s. 6d.; Wednesday, £66 7s. 6d. *Three Months*: Thursday, £68 12s. 6d.; Friday, £68 7s. 6d.; Monday, £67 12s. 6d.; Tuesday, £67; Wednesday, £66 15s.

Tin.—The position in the standard tin market though intrinsically sound, has been affected to some extent by the unfavourable outlook in Continental countries, and buying has been mostly on a more restricted scale than of late. Consequently the tone of the market has been variable, but the range of fluctuations has not been very wide and a fair daily turnover of metal is reported Only a moderate business has been done with the Straits, and it is understood that some sales have been made of Banca at very full prices, this brand at present being in good demand from the Continent. America has shown rather more disposition to buy, and there has been a better inquiry from the Continent. Current quotations:—*Cash*: Thursday, £194 2s. 6d.; Friday, £192 5s.; Monday, £190; Tuesday, £187 15s.; Wednesday, £190 10s. *Three Months*: Thursday, £194 10s.; Friday, £193; Monday, £190 17s. 6d.; Tuesday, £188 12s. 6d.; Wednesday, £191.

Spelter.—The market for spelter, influenced by easier conditions in America and a restricted trade demand for home consumption, has evidenced a downward tendency with a consequent weakening of values. Current quotations:—*Ordinary*: Thursday, £29 10s.; Friday, £29 10s.; Monday, £29 10s.; Tuesday, £29 5s.; Wednesday, £29.

Lead.—The market for soft foreign pig continues quiet, but the tone is a shade firmer on reports of a future shortage of the metal. Most consumers are, however, familiar with these rumours, mostly inspired by speculative operators with a view to encourage the more timid buyers. Current quotations:—*Soft foreign (prompt)*: Thursday, £25 15s.; Friday, £25 15s.; Monday, £25 10s.; Tuesday, £25 2s. 6d.; Wednesday, £25 2s. 6d.

BY.——BUY——

YORKSHIRE SAND

(WE MEAN)

PICKERING SAND

FROM

The County Sand Quarries

WE HAVE ADDED, DURING **LAST FEW WEEKS**

Over ONE HUNDRED FIRMS

TO OUR LONG LIST OF ESTEEMED CUSTOMERS, WHICH INCLUDES THE PRINCIPAL FOUNDERS IN THE KINGDOM.

Our Sand has a reputation all its own.

IT HAS NO SUBSTITUTE

OTHERS SAY *PICKERING SAND IS BETTER— than the sand they thought was best*

WHAT FURTHER PROOF IS NEEDED?

Consistent with Value —— IT IS THE CHEAPEST SAND ON THE MARKET.

IT IS SPECIALLY ADAPTED FOR STEEL FOUNDERS, and GENERAL FOUNDRY WORK.

We claim to have the largest deposit, and best FOUNDRY SAND IN THE WORLD. OWN RAILWAY. PROMPT DELIVERIES. SPECIAL EXPERT ADVICE FREE.

APPLY: **The PICKERING SAND Co., Ltd.**

THE COUNTY SAND QUARRIES PICKERING YORKSHIRE

'PHONE: 5 PICKERING. WIRE: "SAND CO. PICKERING."

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	66 7 6
Three months	66 15 0
Electrolytic	73 10 0
Tough	70 0 0
Best selected	70 0 0
Sheets	100 0 0
India	87 0 0
Wire bars	74 0 0
Do. July	74 0 0
Do. August	74 0 0
Ingot bars	73 15 0
H.C. wire rods	78 0 0
Off. aver., cash, May	67 10 6 3/22
Do. 3 mths., May	68 4 9 11/22
Do. Settlement, May	67 10 0
Do. Electro, May	76 18 7 7/11
Do. B.S., May	71 12 9 1/2
Aver. spot price, copper, May	67 9 4 1/2
Do. Electro, May	77 5 11
Solid drawn tubes	14d.
Brazed tubes	14d.
Wire	11d.
Yellow metal rods	7 1/2d.
Do. 4x4 Squares	9d.
Do. 4x3 Sheets	10d.

BRASS.

Solid drawn tubes	12 1/2d.
Brazed tubes	13 1/2d.
Rods, drawn	11d.
Rods, extruded or rolled	7 1/2d.
Sheets to 10 w.g.	10 3/4d.
Wire	10 1/2d.
Rolled metal	10 1/2d.

TIN.

	£ s. d.
Standard cash	190 10 0
Three months	191 0 0
English	191 0 0
Bars	193 0 0
Chinese	189 15 0
Straits	192 15 0
Australian	192 15 0
Eastern	194 5 0
Banca	193 5 0
Off. aver., cash, May	203 4 5 5/22
Do. 3 mths., May	202 18 6 21/22
Do. Sttlment, May	203 3 4 10/11
Aver., spot, May	203 2 0 1/2

SPELTER.

	£ s. d.
Ordinary	29 0 0
Remelted	26 5 0
Hard	25 0 0
Electro 99.9	34 0 0
English	30 0 0
India	26 5 0
Prime Western	29 10 0
Zinc dust	45 0 0
Zinc ashes	11 10 0
Off. aver., May	31 0 11 13/22
Aver., spot, May	31 1 3 1/2

LEAD.

	£ s. d.
Soft foreign ppt	25 2 6
English	26 10 0
Off. average, May	25 6 7 7/11
Average, spot, May	25 12 3 1/2

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	39 0 0
Do. V.M. ex whf.	38 0 0
Dutch	35 10 0
Rods	44 0 0
Boiler plates	37 0 0
Battery plates	37 0 0

ANTIMONY.

	£ s. d.
English regulus	28 5 0
Special brands	34 10 0
Chinese	26 0 0
Crude	nominal

QUICKSILVER.

	£ s. d.
Quicksilver	10 10 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
45/50%	£13 2 6
75%	£21 0 0
Ferro-vanadium—	
35/40%	16/9 lb. va.
Ferro-molybdenum—	
70/75% c. free	9/- lb.
Ferro titanium—	
23/25%, carbonless	1/2 1/2 lb.
Ferro-phosphorus, 20/23%,	£27 10
Ferro-tungsten—	
80/85%, carbon free	1/5 1/2 lb.
Tungsten metal powder—	
98/99%	1/19 1/2 lb.
Ferro-chrome—	
4/6% car.	£23 10
6/8% car.	£22 10
8/10% car.	£21 10
Ferro-chrome—	
Max. 2% car.	£52 0
Max. 1% car.	£62 0
Max. 0.70% car.	£72 0
67/70%, carbonless	1/6 lb.
Nickel—99%, cubes or pellets	£135 0
Cobalt metal—98/99%	12/- lb.
Aluminium—98/99%	£115
Metallic Chromium—	
96/98%	4/6 lb.
Ferro-manganese (net)—	
76/80%, loose	£18
76/80%, packed	£19
76/80%, export	£20
Metallic manganese—	
94/96%, carbonless	2/- lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s. d.
Finished bars, 14% tungsten	2 6
Finished bars, 18% tungsten	3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. to 8 in. inclusive 4d. lb.

Rounds and squares under 1/4 in. to 1/2 in. 3d. lb.

Flats under 1 in. by 1/8 in. to 1/4 in. by 1/4 in., and all sizes over four times in width over thickness 3d. lb.

Bevels of approved sizes and sections 6d. lb.

If in coils 3d. lb.

Bars cut to length 10% extra

Scrap from high-speed tool steel—

Scrap pieces 3d.

Turnings and swarf 1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£ s. d.	£ s. d.
South Wales—	£ s. d.	£ s. d.
Heavy steel	4 5 0	4 10 0
Bundled steel & shrngs.	3 15 0	4 2 6
Mixed iron & steel	3 17 6	4 2 6
Heavy cast iron	4 0 0	4 5 0
Good machinery for foundries		4 5 0
Cleveland—		
Heavy steel		4 2 6
Steel turnings		3 5 0
Cast-iron borings		3 5 0
Heavy forge		5 1 3
Bushelled scrap		4 5 0
Cast-iron scrap		4 2 6
Lancashire—		
Cast-iron scrap		4 5 0
Heavy wrought		4 10 0
Steel turnings		3 12 6

London — Merchants' buying prices delivered yard.

Copper (clean)	57 0 0
Brass (clean)	37 0 0
Lead (less usual draft)	22 10 0
Tea lead	20 0 0
Zinc	21 10 0
New aluminium cuttings	70 0 0
Braziery copper	50 0 0
Gun metal	48 0 0
Hollow pewter	160 0 0
Shaped black pewter	90 0 0

PIG-IRON.

N. E. Coast—	
Foundry No. 1	127/6
Foundry No. 3	116/-
Forge No. 4	110/-
Mottled	—
Hematite No. 1	116/-
Hematite M/Nos.	115/-
Midlands—	
Staffs. common	—
„ part-mine forge	—
„ „ foundry	—
„ Cold blast, ord.	190/-
„ „ roll iron	200/-
„ basic	—
Northants forge	92/6 to 95/-
„ fdry. No 3	102/6
„ basic	115/-
Derbyshire forge	97/6 to 100/-
„ fdry. No. 3	105/- to 107/6
„ basic	115/-
Scotland—	
Foundry No. 1	117/6
„ No. 3	112/6
Hematite M/Nos.	122/6
Sheffield (d/d district)—	
Derby forge	101/-
„ fdry No. 3	108/6
Lincs. forge	110/-
„ foundry No. 3	115/-
„ basic	130/-
E.C. hematite	124/3
W.C. hematite	125/-

All d/d in the district.

Lancashire (d/d eq. Man.) —	
Derby forge	—
„ foundry No. 3	113/6
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
„ foundry No. 3	—
Dalzell, No. 3	129/6
Summerlee, No. 3	129 6
Glengarnock, No. 3	129/6
Gartsherrie, No. 3	129/6
Monkland, No. 3	129/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£ s. d.
Iron—	
Bars (cr.)	£12 to 12 5 0
Angles	12 5 0
Tees to 3 united ins.	12 10 0
Nut and bolt	11 0 0
Hoops	15 0 0
Marked bars (Staffs.)	14 10 0
Gas strip	13 0 0
Bolts and nuts, 1/4 in. × 4 in.	20 10 0
Steel—	
Ship plates	10 10 0
Boiler plates	14 0 0
Chequer plates	11 5 0
Angles	10 0 0
Tees	11 0 0
Channels	10 5 0
Joists	10 0 0
Rounds & squares 3 in. to 5 1/4 in.	10 15 0
Rounds under 3 in. to 1/4 in.	10 10 0
Flats, over 5 in. wide and up	11 0 0
Flats, 5 in. to 1 1/2 in.	10 5 0
Rails, heavy	10 10 0
Fishplates	14 10 0
Hoops (Staffs.)	12 10 0
Black sheets, 24 g.	14 0 0
Galv. cor. sheets, 24 g.	19 5 0
Galv. fencing wire, 8 g. plain	18 5 0
Rivets, 3/4 in. dia.	14 15 0
Billets, soft	£8/0/0 to 8 10 0
Billets, hard	10 15 0
Sheet bars	£8/10/0 to 8 15 0
Tin bars	9 2 6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 3
Sheet	1 4 1/2
Wire	1 4 1/2
Rods	1 3
Tubes	1 6 1/2
Castings	1 1 1/2

Delivery 3 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3 1/2 to 1/9 1/2
To 15 in. wide	1/4 to 1/10
To 18 in. wide	1/4 1/2 to 1/10 1/2
To 21 in. wide	1/5 1/2 to 1/11 1/2
To 25 in. wide	1/6 1/2 to 2/0 1/2
Ingots for spoons and forks	9d. to 1/3
Ingots rolled to spoon size	1/- to 1/6
Wire round—	
3/0 to 10 G.	1/6 1/2 to 2/1 1/2

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	30.76
No. 2 foundry, Valley	29.00
No. 2 foundry, Birm.	25.50
Basic	25.73
Bessemer	30.77
Malleable	27.23
Grey forge	30.27
Ferro-manganese 80% delivered	130.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	43.00
O.-h. billets	45.00
O.-h. sheet bars	45.00
Wire rods	51.00
	Cents.
Iron bars, Phila.	2.72
Steel bars	2.40
Tank plates	2.50
Beams, etc.	2.50
Skelp, grooved steel	2.45
Skelp, sheared steel	2.45
Steel hoops	3.30
Sheets, black, No. 28	3.85
Sheets, galv., No. 28	5.00
Sheets, blue an'l'd, 9&10	3.00
Wire nails	3.00
Plain wire	2.75
Barbed wire, galv.	3.80
Tinplate, 100-lb. box	$5.50

COKE (at ovens).

Welsh foundry	40/- to 45/-
„ furnace	30/- to 35/-
Durham & North. fdy.	45/-
„ furnace	38/- to 39/-
Other Districts, fndy	47/6
„ furnace	29/- to 30/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	23/3
„	28×20, „	46/6
„	20×10, „	33/9
„	18 3/4×14, „	24/1 1/2
C.W.	20×14, „	22/1 1/2
„	28×20, „	44/3
„	20×10, „	30/10 1/2
„	18 3/4×14, „	22/9
Terneplates	28×20, „	43/-

TUBES.

Gas ..	..53½%	Tube prices are now free.
Water	..48½%	
Steam	..43½%	

SWEDISH IRON.

Bars, hammered basis sizes—Basis price £22 to £23

Rolled Ordinary—Assortment ..	£ s. d.
Nail Rods—Square, round and flats ..	18 0 0 to 18 10 0
Keg Steel	nom. £38 to £40
Faggot Steel	nom. £30 to £32
Blooms—Single welded ..	£10 to £11
Billets—Single and double welded	£13 to £14
Pig-iron—Grey, white or mottled	£7/10 to £7 12 6

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
June 14	68	5	0	dec.	2/6
„ 15	68	0	0	„	5/–
„ 18	67	5	0	„	15/–
„ 19	66	12	6	„	12/6
„ 20	66	7	6	„	5/–

Electrolytic Copper.

June 14	74	10	0	No change	
„ 15	74	10	0	„	
„ 18	74	0	0	dec.	10/–
„ 19	73	10	0	„	10/–
„ 20	73	10	0	No change	

Standard Tin (cash).

June 14	194	2	6	dec.	47/6
„ 15	192	5	0	„	37/6
„ 18	190	0	0	„	45/–
„ 19	187	15	0	„	45/–
„ 20	190	10	0	inc.	55/–

Tin (English ingots).

June 14	194	10	0	dec.	45/–
„ 15	192	10	0	„	40/–
„ 18	190	10	0	„	40/–
„ 19	188	5	0	„	45/–
„ 20	191	0	0	inc.	55/–

Zinc Sheets (English).

June 14	39	0	0	No change
„ 15	39	0	0	„
„ 18	39	0	0	„
„ 19	39	0	0	„
„ 20	39	0	0	„

Spelter (ordinary).

June 14	29	10	0	dec.	7/6
„ 15	29	10	0	No change	
„ 18	29	10	0	„	
„ 19	29	5	0	dec.	5/–
„ 20	29	0	0	„	5/–

Lead (English).

June 14	27	0	0	dec.	5/–
„ 15	27	0	0	No change	
„ 18	26	15	0	dec.	5/–
„ 19	26	10	0	„	5/–
„ 20	26	10	0	No change	

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE MIXED NUMBERS F.O.T.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1915	.. 83 11	.. 88 6	.. 94 8	..107 0	..102 6	..101 3	.. 98 9	.. 98 7½	.. 96 6	..104 0	..124 1	..130 0	..106 11½
1916	..133 9	..140 0	..136 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..128 1½
1917	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6
1918	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6	..122 6
1919	..122 6	..122 6	..122 6	..122 6	..179 2	..190 0	..197 6	..200 0	..200 0	..200 0	..200 0	..200 0	..171 4
1920	..220 0	..220 0	..240 0	..260 0	..260 0	..260 0	..260 0	..260 0	..260 0	..260 0	..260 0	..260 0	..251 8
1921	..240 0	..220 0	..180 0	..180 0	..160 0	..160 0	..160 0	..160 0	..137 0	..127 6	..117 6	..104 6	..162 2
1922	.. 97 6	.. 91 7½	..100 0	.. 98 6	.. 97 1½	.. 94 7	.. 93 6	.. 90 9	.. 89 7	.. 91 10½	.. 93 0	.. 93 2	.. 94 5½

AVERAGE PRICES OF STEEL RAILS.

Year.	Jan	Feb	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1908	.. 6 2 6..	6 0 0 ..	6 0 0..	5 15 6..	5 15 0..	5 15 0..	5 15 0..	5 15 0..	5 15 0..	5 15 0..	5 15 0..	5 10 0 ..	5 16 3
1909	.. 5 5 0..	5 5 0 ..	5 5 0..	5 0 0..	5 5 0..	5 5 0..	5 5 0..	5 5 0..	5 5 0..	5 5 0..	5 5 0..	5 5 0 ..	5 5 0
1910	.. 5 5 0..	5 7 6 ..	5 7 6..	5 10 0..	5 10 0..	5 10 0..	5 10 0..	5 10 0..	5 10 0..	5 10 0..	5 10 0..	5 10 0 ..	5 8 11½
1911	.. 5 15 0..	5 15 0 ..	5 15 0..	5 12 6..	5 12 6..	5 12 6..	5 12 6..	5 12 6..	5 12 6..	5 12 6..	5 12 6..	5 12 6 ..	5 13 1½
1912	.. 5 13 1..	5 15 0 ..	5 15 0..	5 15 7..	6 1 6..	6 6 3..	6 7 6..	6 8 0..	6 11 3..	6 12 6..	6 12 6..	6 13 9 ..	6 4 4
1913	.. 6 15 0..	6 14 4½..	6 12 6..	6 12 6..	6 12 6..	6 12 6..	6 12 6..	6 12 6..	6 10 0..	6 10 0..	6 10 0..	6 10 0 ..	6 12 0
1914	.. 6 10 0..	6 10 0 ..	6 6 3..	6 0 0..	6 0 0..	6 0 0..	5 14 0..	6 2 6..	6 13 9..	6 12 0..	6 7 6..	6 7 6 ..	6 5 3½
1915	.. 6 10 6..	6 17 6 ..	7 5 0..	7 12 6..	7 12 6..	7 17 6..	8 17 6..	9 2 6..	9 2 6..	9 2 6..	9 7 6..	10 10 6 ..	8 6 6½
1916	..10 19 4..	11 0 0 ..	11 0 0..	10 18 9..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6 ..	10 9 10
1917	..10 17 6..	10 17 6 ..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6 ..	10 17 6
1918	..10 17 6..	10 17 6 ..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6..	10 17 6 ..	10 17 6
1919	..10 17 6..	13 7 6 ..	13 7 6..	13 7 6..	15 0 0..	15 10 0..	16 0 0..	16 10 0..	16 10 0..	16 10 0..	16 10 0..	17 5 0 ..	14 12 11½
1920	..18 15 0..	19 5 0 ..	20 7 6..	22 0 0..	23 0 0..	24 0 0..	25 0 0..	25 0 0..	25 0 0..	25 0 0..	25 0 0..	25 0 0 ..	22 18 11
1921	..23 5 0..	20 4 0 ..	18 0 0..	17 0 0..	15 0 0..	15 0 0..	14 0 0..	14 0 0..	14 0 0..	11 12 6..	10 10 0..	10 0 0 ..	15 4 3
1922	.. 9 10 0..	9 10 0 ..	9 10 0..	9 10 0..	9 10 0..	9 10 0..	9 10 0..	9 0 0..	8 15 0..	8 15 0..	8 15 0..	8 15 0 ..	9 4 2

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
5, MURZBAN ROAD, BOMBAY.
1, LALL BAZAR, CALCUTTA.
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Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 7 words per line. Minimum charge for one insertion 3/-.

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PATENTS.

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MACHINERY, PLANT, &c.

7 in. x 72 in. PLAIN GRINDING MACHINE, with countershaft, by Brown & Sharpe. 20 in. stroke DOUBLE HEADED SHAPING MACHINE, two T-slotted tables 24 in. x 18 in. x 16 in. deep, by J. Spencer & Company, Limited. Two No. 3 Kempsmith UNIVERSAL MILLING MACHINES, table 52 in. x 12 in., with equipment. 14 in. centres "Deutches Niles" SURFACE, SLIDING and SCREW-CUTTING LATHE on 20 ft. straight bed. 6 first-class LANCASHIRE BOILERS, 30 ft. x 8 ft., reinsurable working pressure of 140 lbs. per sq. in. One NEARLY NEW STEEL LANCASHIRE BOILER, 30 ft. x 9 ft., reinsurable at 100 lbs. working steam pressure, complete with steam and furnace fittings, etc. 1 ton, four motor, electric travelling, underhung JIB CRANE, span 20 ft. 7½ in., built by Messrs. Craven Bros., Manchester, in 1905, suitable for current at 480 volts continuous, main girders 14 in. x 6 in., R.F.J., with 56 lbs. bridge rails riveted on all motors by Siemens. Crane has been little used and is in good working order. All motions controlled from cage.

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GENERAL FOUNDRY & ENGINEERING Co., Ltd.,
ARLESEY, near HITCHIN.
HENRY BUTCHER & COMPANY
will sell by Auction on
TUESDAY, JULY 3, 1923, and Following Day, at 11.30 a.m. each day.
THE VALUABLE
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